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ABSTRACT

The third in a series of leaflets designed for dissemination of information on school building, this publication describes the method of school building developed by the Centre de Rationalisation et d'Organisation des Constructions Scolaires (C.R.O.C.S.) in the Commune de Lausanne, Switzerland. In Lausanne, the concurrence of lengthening students' years in school with a rise in the school population created a need for 10 schools to be constructed between 1965 and 1975. Four architects agreed to collaborate to develop a rationalized system of building schools. Educators and architects actively participated in a study to define the spatial requirements, furniture, and equipment for, and the environmental needs of, modern teaching methods. The study resulted in an exhaustive brief of the architectural, technical, and financial requirements that would be basic to all new Lausanne schools. Graphic and narrative descriptions are provided of the geometry of the system; the primary structural elements; the secondary nonstructural and environmental elements; and the interior finishes, furnishings, and equipment. (Author/MLF)

OECD

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PROGRAMME ON EDUCATIONAL BUILDING

C.R.O.C.S.

A Swiss Industrialised School Building System

BY PAUL LENSSEN

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
PARIS AUGUST 1973

The Organisation for Economic Co-operation and Development (OECD) was set up under a Convention signed in Paris on 14th December, 1960, which provides that the OECD shall promote policies designed:

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- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;

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The Programme on Educational Building (PEB) was established by the Council of the Organisation for Economic Co-operation and Development for an initial period of three years as from January 1972.

The main objectives of the Programme are:

- 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.

The Programme functions within the Directorate for Scientific Affairs of the Organisation in accordance with the decisions of the Council of the Organisation, under the authority of the Secretary-General. It is directed by a Steering Committee of senior government officials, and financed by participating governments.

C. R. O. C. S.

A SWISS INDUSTRIALISED SCHOOL BUILDING SYSTEM

leaflet
by

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Educational Building
Secretariat, O.E.C.D.

The word 'system' as applied to methods of building - whether it be school building or any other - has now achieved such frequency of use as to obscure any meaning it might once have had. 'System building' invariably carries with it connotations of industrialised techniques, prefabrication of building elements, speed and efficiency of construction and a whole variety of economic advantages over non-system or traditional alternatives. In it is seen the answer to the host of intractable problems arising from the need to satisfy an enormous volume of demand for building accommodation with limited time, money and other resources available. It has become, in short, a catch-phrase, the use or non-use of which betrays knowledge or ignorance of the panacea for most, if not all, problems facing those charged with the provision of built accommodation.

This is not to say that there is no validity in the concepts behind the term. Of course there is, as experience in many countries shows. To assess this, however, it is necessary to examine what a building 'system' really implies, in what way it differs from conventional procedures, the nature of the advantages it offers or constraints it imposes, and the extent to which the ideas it embodies are applicable in widely differing political, administrative, institutional, legislative, geographical, social, economic, industrial etc., circumstances. Although created as a specific response to a particular set of circumstances, the method of school building developed by the "Centre de Rationalisation et d'Organisation des Constructions scolaires" (C.R.O.C.S.) in the Commune de Lausanne, Switzerland - and which forms the subject of this leaflet - is thought to demonstrate well various aspects of system building for educational purposes which have a wider application than in the locality in which it originated. Lessons to be learnt concern less the 'nuts and bolts' aspects or 'hardware' - the materials used, the module chosen, constructional details, etc., (interesting though they are) - than those related to the origins and raison d'être of the system, its declared aims, the associated administrative and development procedures and its subsequent application to the planning and design of individual projects.

In Switzerland education is the ultimate responsibility of the Canton which is charged with all matters concerning curriculum and educational method. While the Canton provides assistance to the Communes in the form of grants for school building, the Commune itself determines the need for schools and is responsible administratively for providing them. The development of C.R.O.C.S. as a system of industrialised building lay primarily in initiatives undertaken by the Commune of Lausanne in 1965, which in turn sprang out of a survey of the educational needs of Lausanne over the following decade.

The pattern assumed by those needs is a familiar one. There were to be educational reforms: children were to start school a year earlier and leave a year later, and there was to be re-grouping in secondary education. In Lausanne itself a continuing growth in the school population was also forecast. The concurrence of educational change with a rise in the school population established a need for ten schools over a period of a decade from 1965. While by the standards of many Authorities such a programme was by no means large, nevertheless for the Commune of Lausanne it was large enough to provoke a reconsideration of the traditional methods of building schools, especially at a time when, using these methods, the cost of building schools was rising and the time taken to build them lengthening.

This initiative found a response. Four architects in private practice in Lausanne agreed to collaborate to develop a rationalised system of building schools and out of this partnership C.R.O.C.S was born. The method of proceeding they adopted was significant and one which had the blessing of the educational authorities, Before the system was devised, there was a detailed analytical study of educational requirements. Close and continuous collaboration was established between representatives of the education authorities, head teachers, teachers and architects. This collaboration helped to identify both current teaching methods and possible future forms of teaching although the latter were expressed inconclusively and served only to point out the need for school buildings to be as adaptable as possible. The study involved an analysis of school time-tables in terms of the number of subjects taken and of the time spent on them each week, the translation of that analysis into general purpose and specialist rooms, a study of educational groupings possible within a room and an inventory of furniture and equipment required by both pupils and staff. The purpose behind this study was threefold: first, to ensure the active participation of architects, administrators and teachers from the outset in the development of the system and to avoid the loss of time and misunderstandings which in the past had made their collaboration less productive than it might have been; second, to define the spatial requirements, the furniture and equipment, and the environmental needs of modern teaching methods and ensure their incorporation in all new Lausanne schools; and third, to compile an exhaustive brief of the architectural, technical and financial requirements for the benefit of the executive architects to whom individual projects were to be entrusted.

The research in these fields enabled a number of requirements to be framed covering the following aspects:

- Location of school buildings in the urban context, i.e. recommended travelling distances for pupils according to age; road safety measures and pedestrian/vehicular segregation; proximity of means of transport; protection against traffic etc., noise and nuisance.
- Criteria for choice of site, i.e. topography, nature of the ground, environmental considerations, space for pupils' outdoor activities, micro-climate conditions - humidity, wind direction and orientation.
- Forms of school building corresponding to differing levels of education, ages of children and curricular structures.
- Relationships on single sites between these different forms of building.

- Standards of lighting (natural and artificial), acoustics, heating and ventilation.
- General-purpose teaching space (see Figure 1).
- Teaching methods (see Figure 2).
- Provision of teaching aids : fixed equipment, audio-visual material etc., (see Figure 3).
- Intensity of use of accommodation (see Figures 4a and 4b).
- Ancillary areas : administration, lavatories, caretaker etc.
- Relationship of accommodation groupings housing different activities and the circulation of pupils and teachers between these accommodation groupings.

To satisfy these requirements in as economical a way as possible various alternative proposals - for example for the structural system - were analysed and costed. As a result the architectural conception emerged : the geometry of the system, the primary structural elements, the secondary non-structural and environmental elements, and the interior finishes, furnishing and equipment.

It is claimed that the cost in fees of this extensive study, which took about two years to carry out, were more than justified by the subsequent economies made in the actual construction process. The study itself cost 1.5% of the amount spent on the ten schools whereas the savings in construction amounted to between 15% and 18% of the cost had traditional procedures been followed.

The system is regulated by a module in both plan and section. In plan the modular grid (based on the internationally agreed 10cm module) is made up of three rectangles - 0.60m x 0.60m, 2.40m x 2.40m and 2.40m x 0.60m - juxtaposed to resemble a Scotch tartan (see Figure 5).

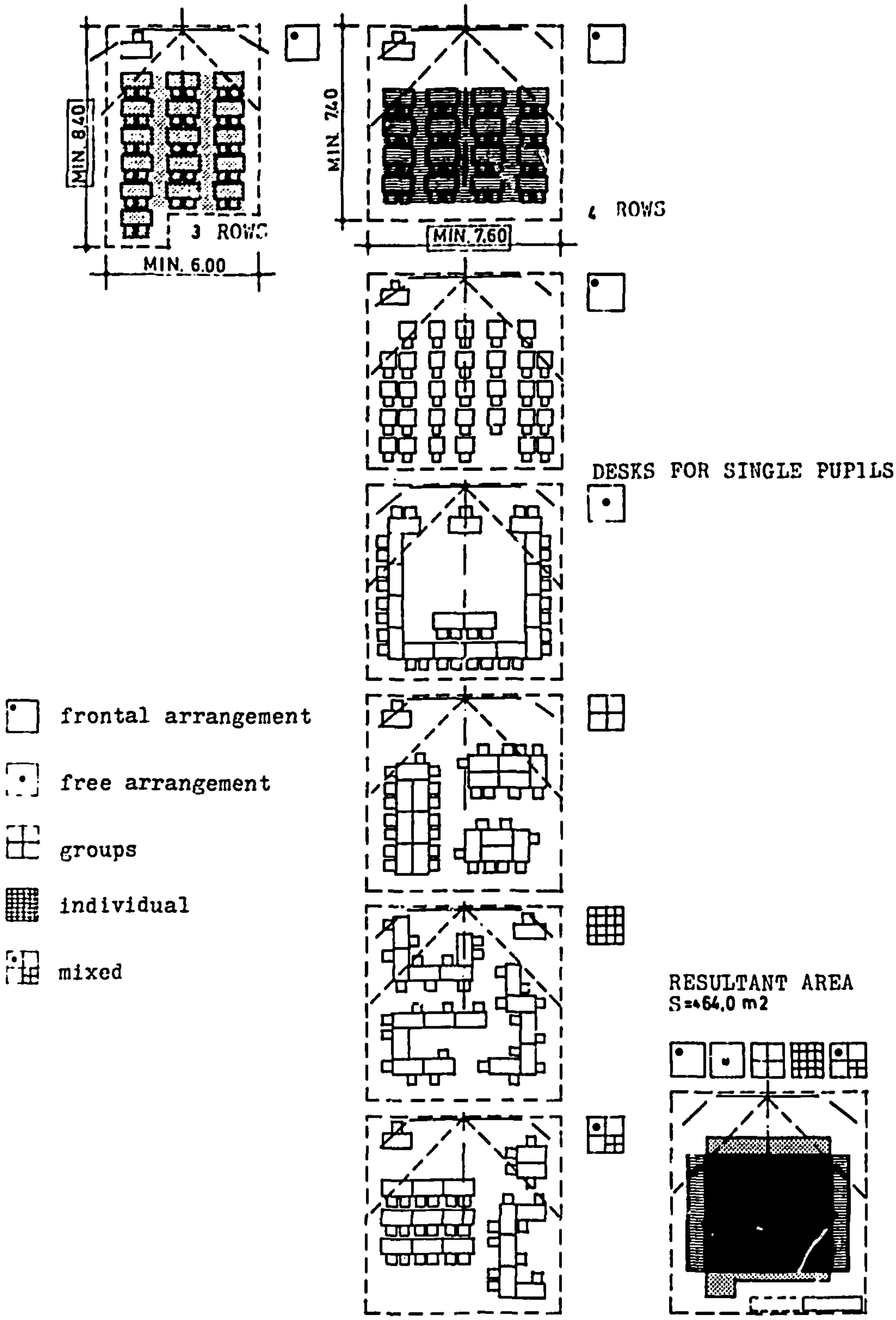


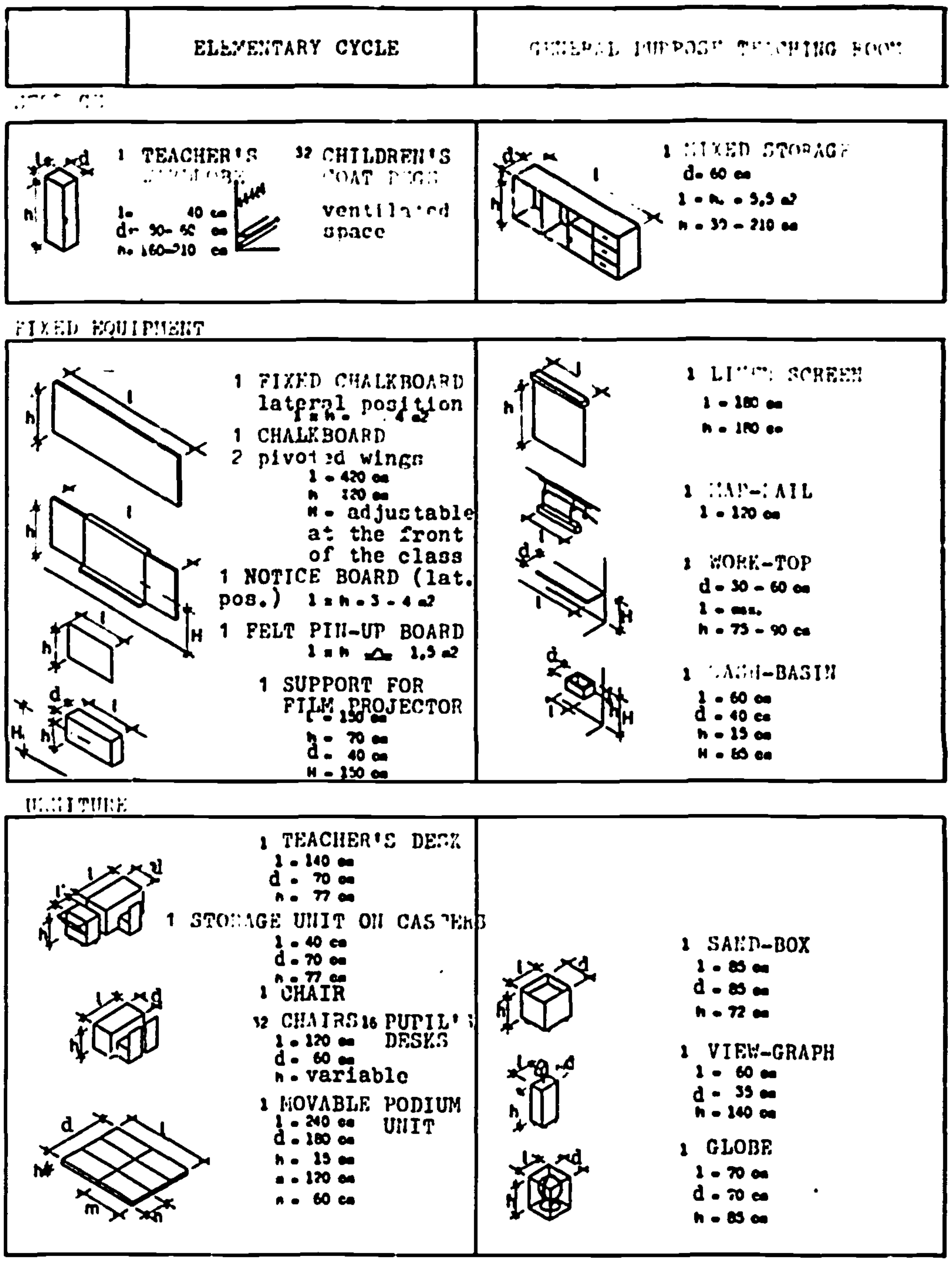
Figure 1 : General Purpose Teaching Rooms (32 pl.) : Teaching Space (Elementary Cycle)

ELEMENTARY CYCLE								
			ORGANISATION OF WORK					
SUBJECTS	Number of pupils per master	Number of hours per week	Arrangement for several classes	Frontal arrangement	Free arrangement	Groups	Individual	Mixed
FRENCH	32/1	7-10		50%	25%	25%		
HISTORY	32/1	1		50%	25%	25%		
GEOGRAPHY	32/1	$1\frac{1}{2}-2$		50%	25%	25%		
CHRISTIAN EDUCATION	32/1	1-2		50%	50%			
ARITHMETIC GEOMETRY BOOK-KEEPING	32/1	3-6		15%	40%		45%	
NATURAL SCIENCES	32/1	2		50%	25%	13%	12%	
DRAWING	32/1	$2\frac{1}{2}-3\frac{1}{2}$		25%		25%	50%	
MANUAL WORK	16/1	1		10%		20%	60%	10%
SINGING - MUSIC	32/1	2	from time to time		100%			

T E A C H I N G M E T H O D S

THEORETICAL EXPOSITION	INDIVIDUAL WORK	EXPERIMENTATION
DIALOGUE - DISCUSSIONS	PHYSICAL ACTIVITY (games, dancing, crafts)	OUTDOORS

Figure 2 : Teaching Methods



PARTICULAR REQUIREMENTS

NATURAL LIGHTING	multilateral recommended	GAS - AIR	none
ARTIFICIAL LIGHTING	normal	ELECTRICITY	for power
BLACKOUT FACILITIES	partial	ELECTRICITY	for lighting
ACOUSTICS	normal	ELECTRICITY D.C.	none
WATER	cold	VENTILATION	natural, cross

Figure 3 : Teaching Aids

Figure 4a : Method of calculating rate of utilisation

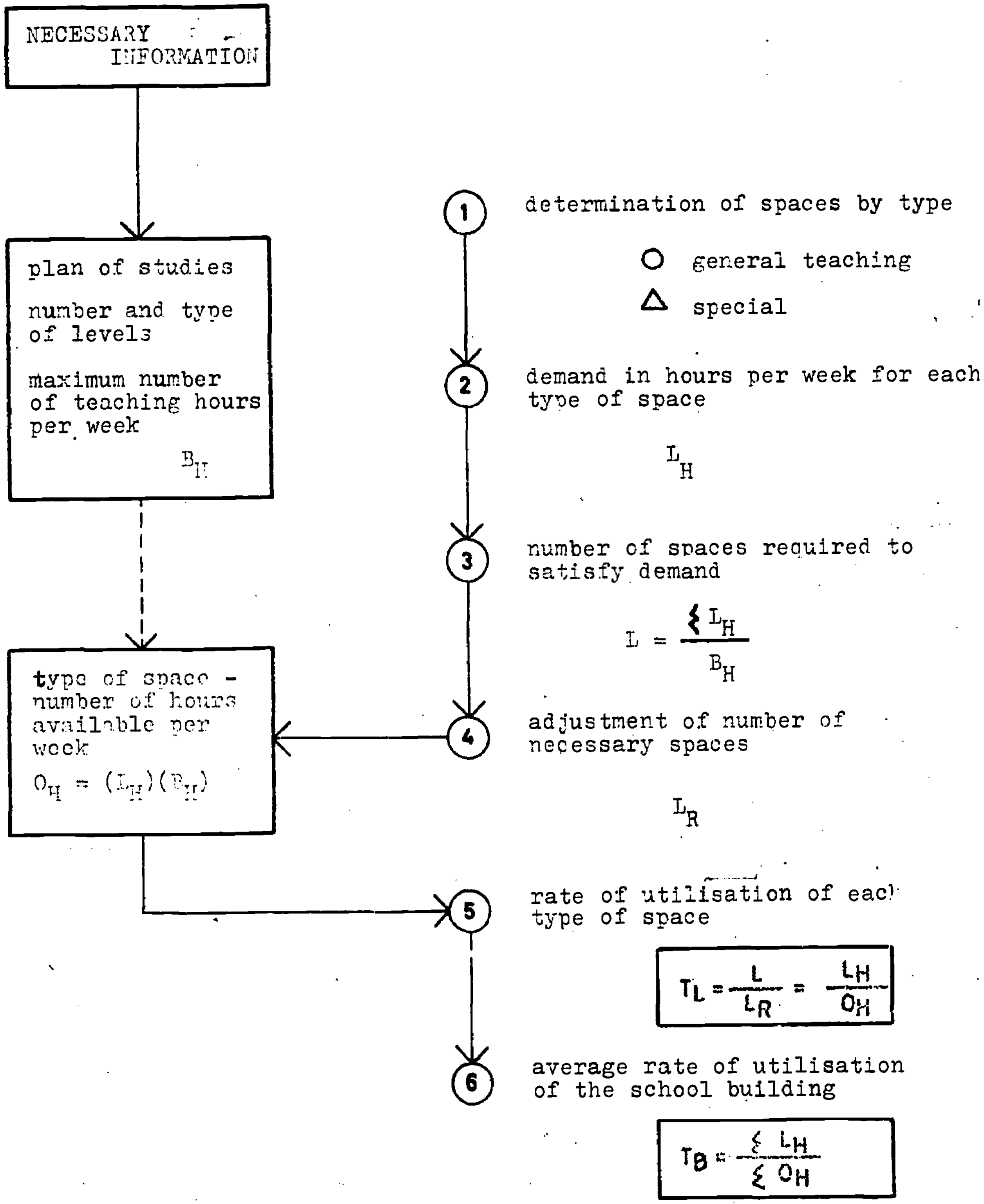


Figure 4b : Method of calculating rate of utilisation
Example of application 1
Existing secondary college - school with 22 classes

	TYPE OF SPACE	L_H	B_H	L	L_R	T_L	%
○	general teaching	363	36	10.01	10		100
△	sciences	55	36	1.52	2		76
△	drawing - light manual work	49	36	1.36	2		68
△	woodwork	14	36	0.39	1		39
△	metalwork	14	36	0.39	1		39
△	languages (laboratory)	35	36	0.97	1		97
△	languages (seminar)	35	36	0.97	1		97
△	singing - music	24	36	0.67	1		67
△	geography, history - ancient history	92	36	2.55	3		85
△	needlework	32	36	0.89	1		89
△	gymnastics	44	36	1.22	2		61
		ΣL_H 757	ΣO_H 900		ΣL_R 25	$T_B = \frac{\Sigma L_H}{\Sigma O_H}$	84

Working hypothesis :

General teaching space for : French, arithmetic, algebra, christian culture, Latin, Greek; 50% languages: German, English, Italian.

Language laboratory : 25% of the languages: German, English, Italian.

Language seminar : 25% of the languages: German, English, Italian.

Needlework : Same number of hours as for manual work.

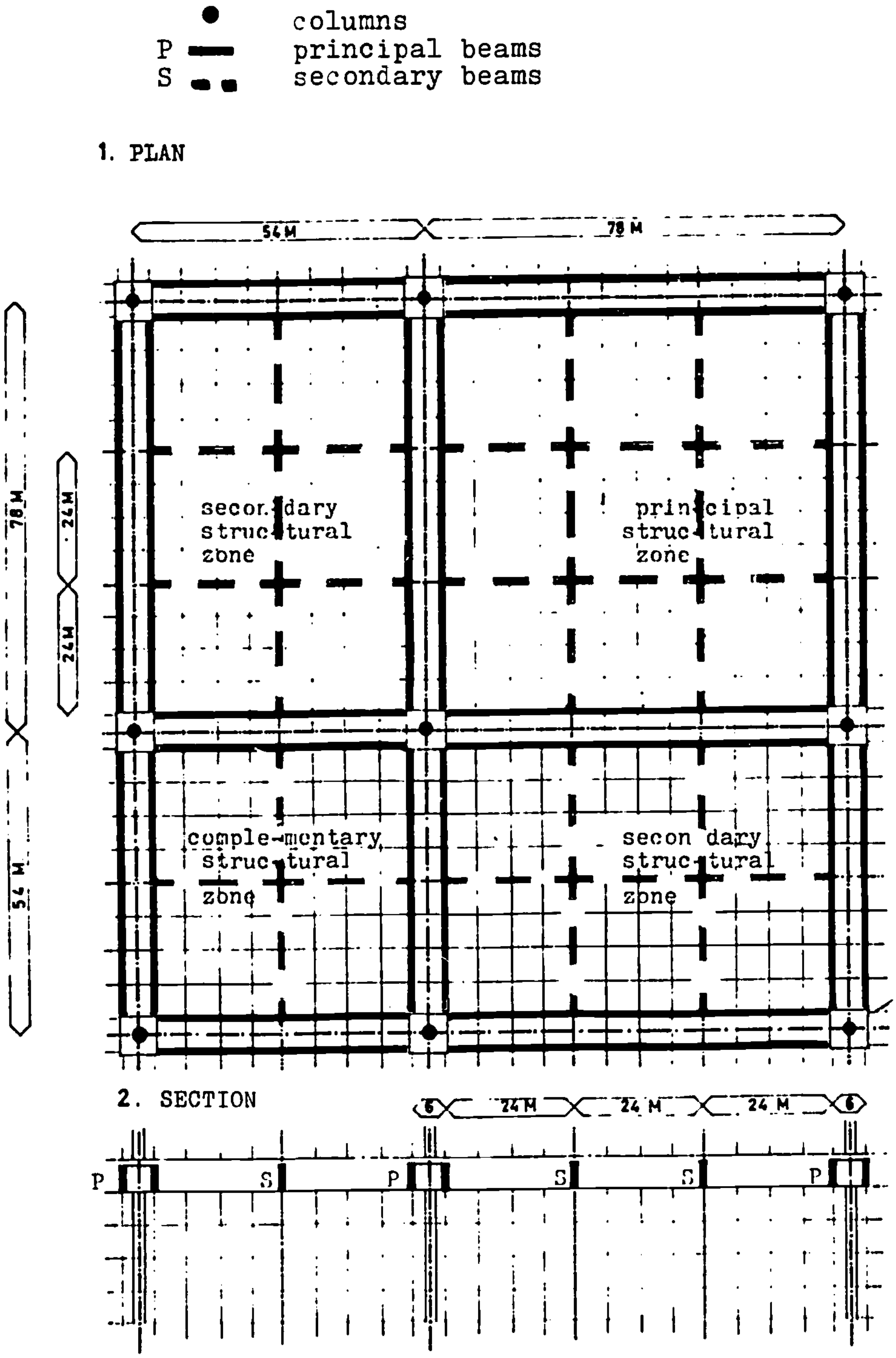


Figure 5 : Rules of composition in plan:
Normal structural layout
Position of columns
Principal and secondary beams

Within this geometry the structural grid is disposed giving rise to three bay sizes of 7.80m x 7.80m, 7.80m x 5.40m and 5.40m x 5.40m. In section two standard floor to ceiling heights are used : 2.40m and 3.00m with an additional 0.60m for the floor or roof zone (see Figure 6).

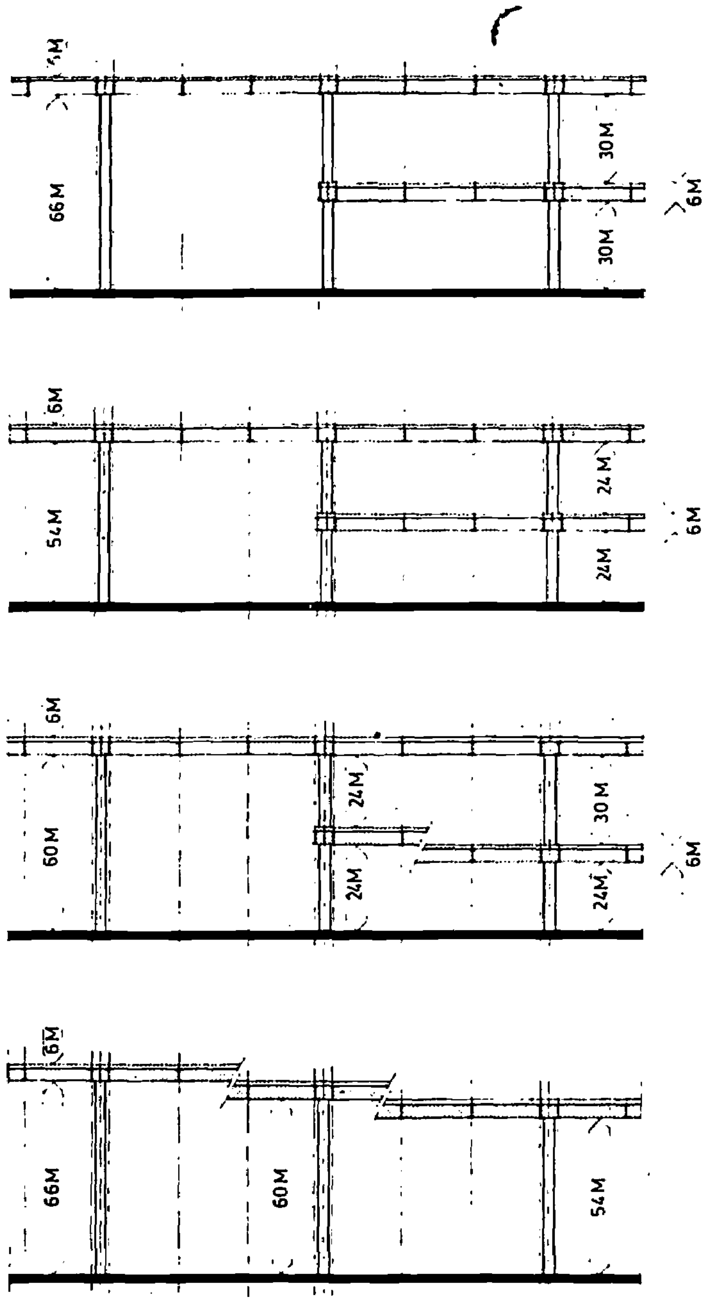


Figure 6 : Rules of composition in section - spaces of normal height and spaces of greater height

The structure itself is a rigid-jointed steel frame comprising : circular colums: I-section steel principal beams (punctured as shown in Figure 7 to allow the passage of services), framed-up steel girder secondary beams; and prefabricated floor and roof units. The principal and secondary beams are contained within the previously mentioned 0.60m floor or roof zone which in addition comprises and contains : the floor and roof screed and units: sound insulation, electricity, gas, water and drainage services; and removable suspended acoustic ceiling panels (see Figure 8). The steel-framed, prefabricated staircases are of five standard types allowing the designer of a school freedom as to which structural zone this aspect of his planning occupies and have treads formed from concave sheet steel filled with concrete and finished with a plastic floor covering. Although permitting any type of internal partition, the system offers a lightweight steel model - with a choice of finishes - which sits on the floor finish and allows demountability and re-use. A barrier of absorbent material is installed in the floor or roof zone on the lines of the partitions to prevent sound transference between adjacent enclosures.

Choice of internal finishes is in no way restricted by the system and in the schools already built a wide range of good quality is to

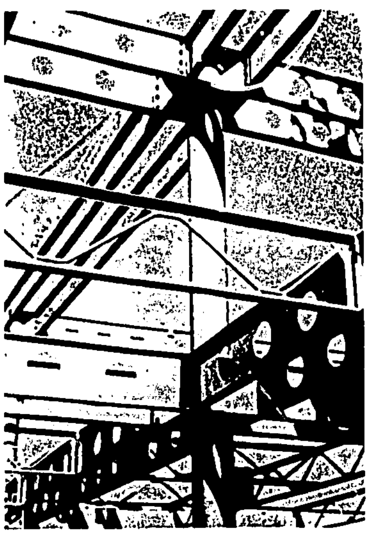


Figure 7 : Steel Frame

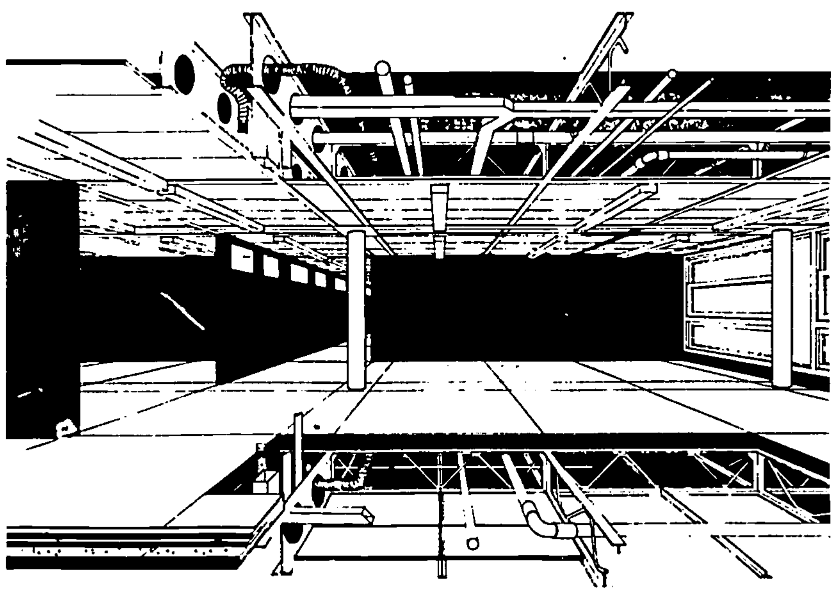


Figure 8 : Sectional Perspective

be seen reflecting the variety of different requirements demanded by different activities : terrazzo, carpet and vinyl floor finishes: enamel and plastic finished partitions; and plain and acoustic ceiling tiles. Of equally high quality are both the range of moveable furniture designed to fit the module of the system and the equipment : storage facilities. chalkboards, projection screens, black-out curtains, moveable podia, etc., (see Figure 9).

The first project to be realised in the system was the "Collège secondaire de Beausobre" (see Figures 10a, 10b and 11), designed by Mr. J.P. Cahen, who was one of the architect members of the C.R.O.C.S. partnership. This project acted as a prototype and tested the theoretical propositions of the study against the realities of the building site. Experience thus gained was fed back into the system in the form of a number of minor technical modifications which were adopted in subsequent projects.

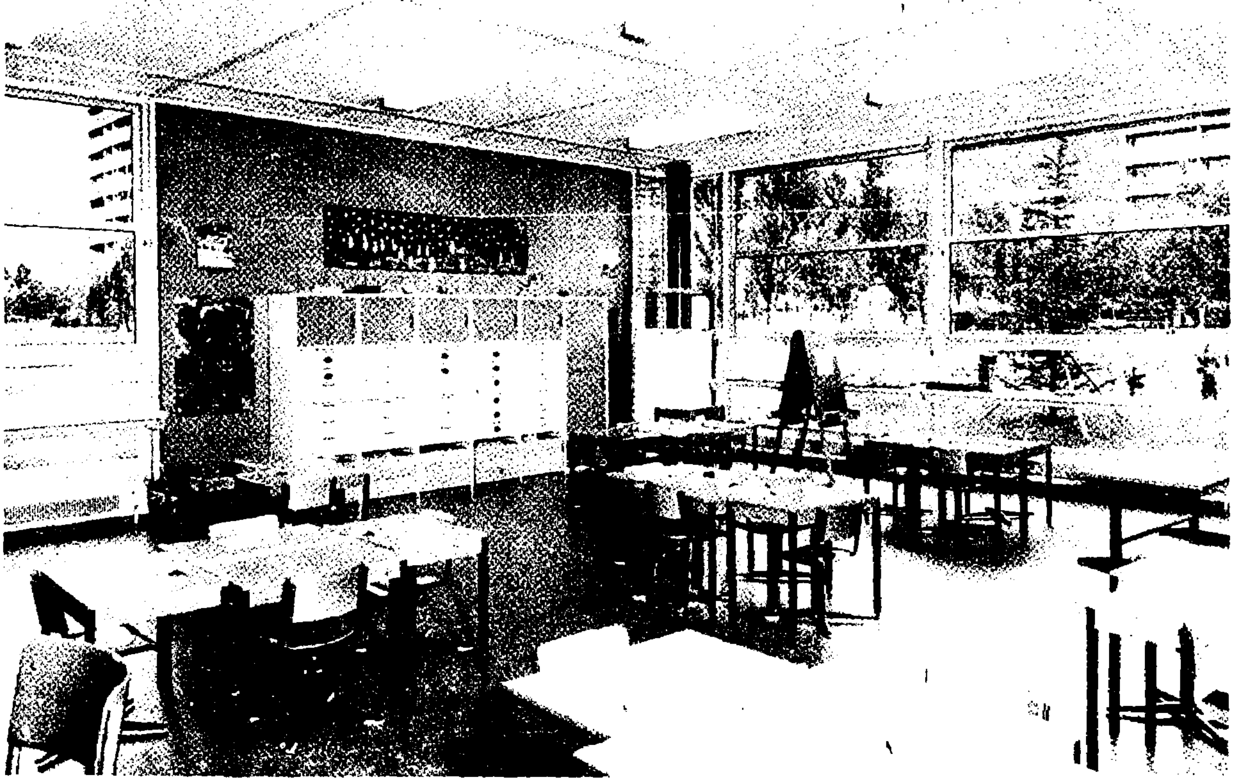


Figure 9 : Interior view of classroom at the college of "la Planchette Aigle"

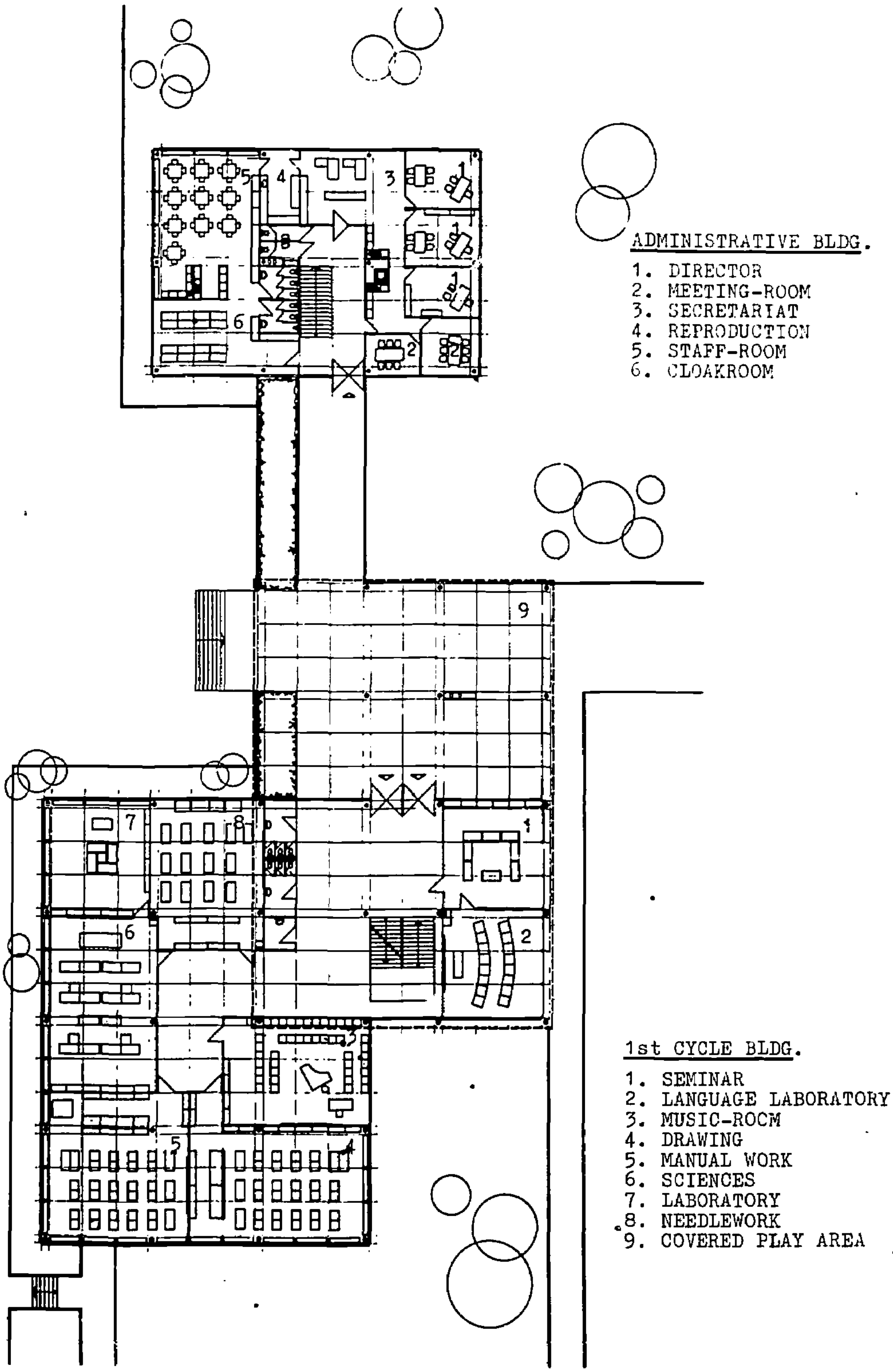
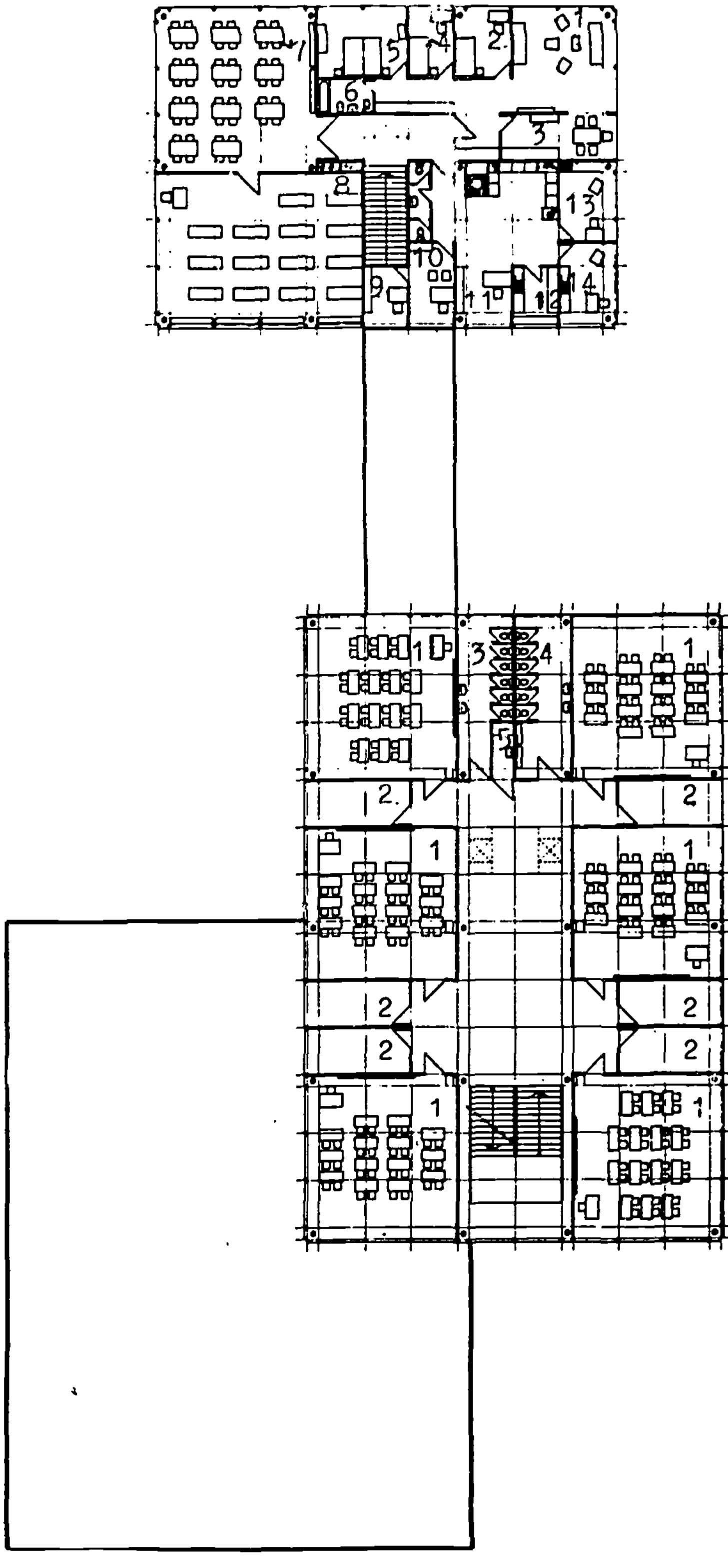


Figure 10a : "Collège secondaire de Beausobre" - ground floor plan



ADMINISTRATIVE

1 to 6 CARETAKER'S FLAT
7. STUDY
8. LIBRARY
9 to 14 DENTAL DEPARTMENT

1st CYCLE GENERAL TEACHING ROOMS

1. GENERAL TEACHING ROOMS
2. CLOAKROOMS
3. GIRLS' LAVATORIES
4. BOYS' LAVATORIES
5. UTILITY

Figure 10b : "Collège secondaire de Beausobre" - upper floors

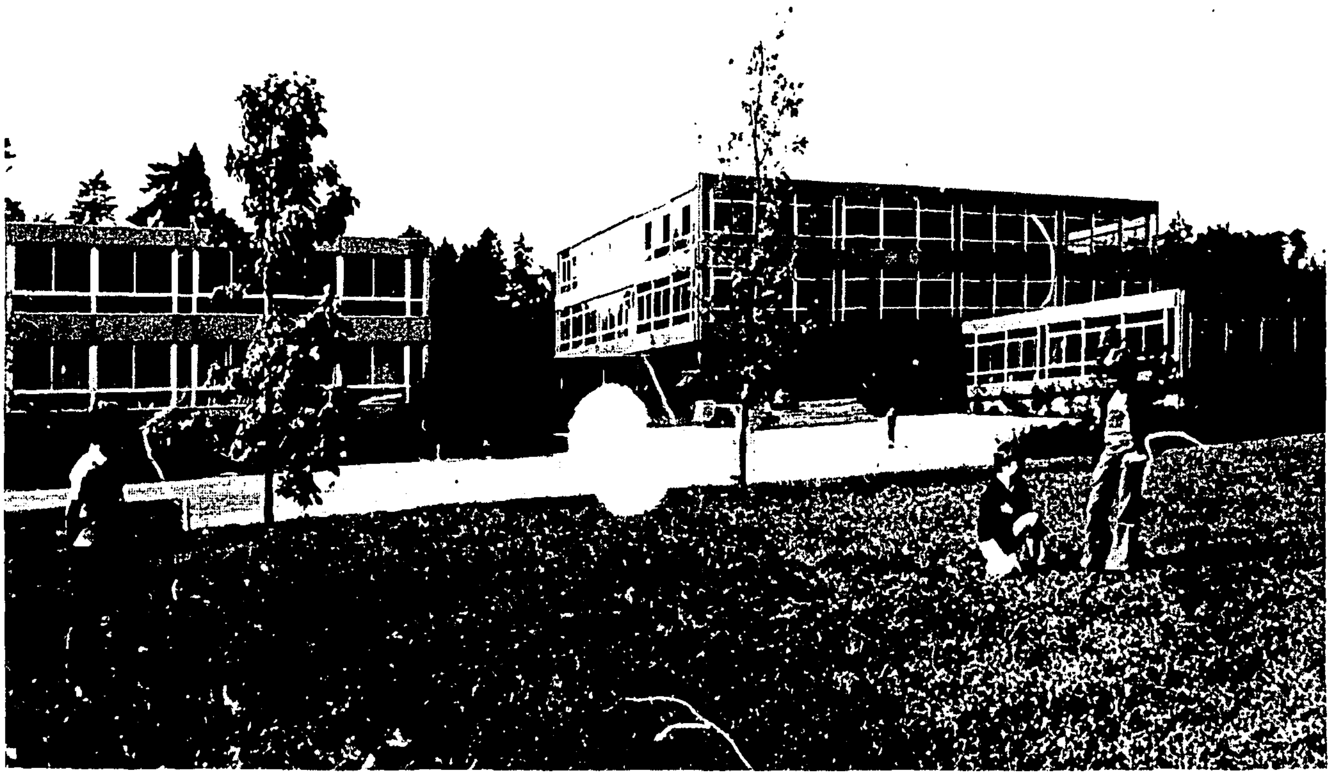


Figure 11 : "Collège secondaire de Beausobre"

The originators of the system make the point that the building methods employed are essentially rationalised traditional rather than prefabricated or industrialised in nature. It is nevertheless evident that a degree of industrialisation and prefabrication is involved yet the distinction they draw is an important one acknowledging - as it does - the difference between 'prefabricated' and/or 'industrialised' building on the one hand and 'system' building on the other. The former describes merely the techniques of construction : the design, production and assembly aspects of and the 'hardware' previously referred to whereas the latter embraces the entire process from the identification of educational - that is non-constructional - needs, the analysis of the building implications of those needs, and their translation into physical reality in the form of schools using techniques of construction most suited to meet them and within the limits of resources available.

The essence, then, of a system of building is the application of a systematic approach to all facets of this entire process. A successful system embodies that approach which considers whatever is pertinent to the planning, design and/or construction of a project. It constitutes a system of interdependent factors the objective of which is the achievement of an optimum combination of user satisfaction and resource and time utilisation. That is to say, the systems approach is a management approach, a discipline and a technique and not merely a method of building. It cannot be over-emphasised that there is no hard and fast line dividing traditional or conventional building methods and industrialised or prefabricated methods. It can be seen that conventional methods in developing countries might not have changed for many years whereas in more industrially advanced countries they already embrace a considerable degree of industrialisation and prefabrication. It is the role of the building system to select the building method it employs, but only as one of five basic steps:

- systematic definition of needs
- systematic analysis of the resultant building implications
- design of system 'hardware'
- use of the system in the implementation of the building programme(s)
- systematic evaluation and feedback.

It is thought that the C.R.O.C.S. system of school building represents a case in which these steps have been recognised and an attempt made to follow them with a not inconsiderable degree of success.

ACKNOWLEDGEMENTS

All figures are by courtesy of "Réalisations scolaires et sportives", Chemin de Rovéréaz 5 (immeuble Migros), Case postale 148, 1012 Lausanne-Chailly, Switzerland.

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.5. : a Canadian "casework", or furniture and equipment system for schools.

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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