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HOUSING TRENDS IN EUROPE - A SEMINAR IN PRAGUE

by

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HOUSING TRENDS IN EUROPE — A Seminar in Prague

by H. Brian Dickens

In April of this year I was privileged to visit Czechoslovakia in order to attend a United Nations Seminar on "Changes in the Building Industry". The Seminar was arranged by the Committee on Housing, Building and Planning of the Economic Commission for Europe, established by the United Nations in 1947 to assist with the tremendous task of reconstruction facing Europe after the war. The main purpose of the Seminar was to review current trends in house building in Europe and to consider the changes taking place within the industry and their effect upon productivity.

The conference was held in Prague, the beautiful capital city of Czechoslovakia, located on the banks of the Vltava (Moldau) River. Founded in the thirteenth century, it now has a population of one million people. The Seminar meetings took place in the Old Town Hall located in the oldest section of the city (Staré Mêsto). This notable building, linked closely with the early history of Prague, was constructed in 1338 and has been renovated several times since, most recently after damage by fire in the revolution of May 1945.

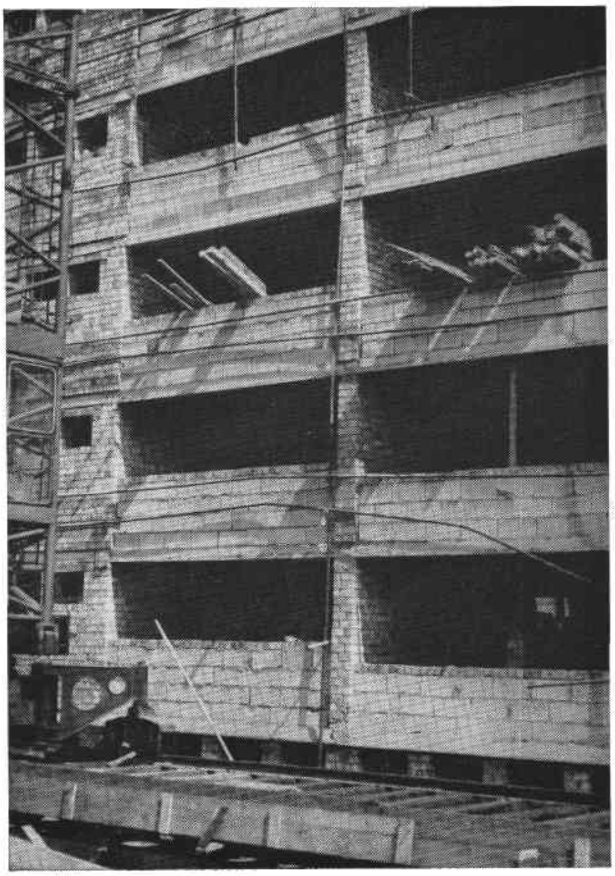
The Seminar was attended by over 100 representatives from 26 countries, and from international groups of which European countries, both East and West, predominated. Representatives like myself from non-European countries attended as observers, although in practice this distinction was largely theoretical and we were permitted to participate fully in all discussions.

The conference began on 20 April and encompassed eight days of intensive discussion organized around the following four topics:

(1) The Structure of the Industry and the Development Process;
(2) The Changing Patterns of Relationships Between Members of the Building Team;
(3) The Problems of Continuity of Demand and of Production; and
(4) Evolution of the Traditional and Industrialized Sectors of the Industry.

National monographs on each country's building industry formed the basis of discussion and analytical reports were prepared on each topic by a representative from Eastern Europe and one from the West.

In this way the conference undertook a broad and critical review of the developments within the building industry in each of the European countries. Each nation was asked to consider carefully the changes that were taking place and to speak frankly about its achievements and its problems. The ensuing discussions emphasized the seriousness of the present housing shortage in Europe and provided a unique opportunity to compare the efforts of the various governments in their search for solutions. The main features of the conference form the background for the dis-



Brick and brick-block construction with in situ concrete floors. (Czechoslovakia)

Figure 1

cussion of housing trends in Europe that follows.

INDUSTRIALIZED BUILDING

Although the conference theme was "Changes in the Structure of the Building Industry", it might well have been called "Industrialized Building". The great impetus given the application of industrial engineering methods to building and particularly to housing since the war is creating the significant changes in the building process that were the main subject of discussion in Prague. Nowhere are these changes more evident than in Europe where so-called "system building" has received considerable attention in recent years as a means of increasing productivity.

One of the most lasting impressions of the conference was this tremendous emphasis on industrialized building. There is an important reason for this. Although the building industries of most European countries are currently working at full capacity, house production in many cases is still from five to ten years behind the demand. It was reported that in some of the early-developed countries as much as one-half the total construction labour force is engaged on repairs and maintenance of old houses. Recent studies of building needs in England indicate that there are at present one million slum dwellings and 2,700,000 substandard dwellings in that country; the output of the industry must increase by more than 50 per cent in the next ten years if the demand for buildings for both social and economic purposes is to be met. There is widely held opinion that only the introduction of industrialized methods will accomplish this, although it was soon evident in Prague that there are quite different views on how this can best be achieved or what it encompasses.

To some the term "industrialized building" suggests a simple choice between two kinds of building, "traditional" or "non-traditional". To others it means the application of modern industrial methods to all phases of the building process, including preparation, planning and execution. This latter was referred to as the rationalization of building, which in an economic sense has been defined as the reform of an industry by eliminating waste in labour, time and materials. As such, the term could apply equally well to traditional or system building, because the determining factor is the way in which construction is organized and carried out and not the construction method itself. As one member put it, a well-organized contractor using traditional building methods can often perform more economically than a poorly-organized one who uses more advanced methods. The construction method, on the other hand, may well affect the degree to which rationalization can be achieved and this is the main reason for the developing interest in system building.

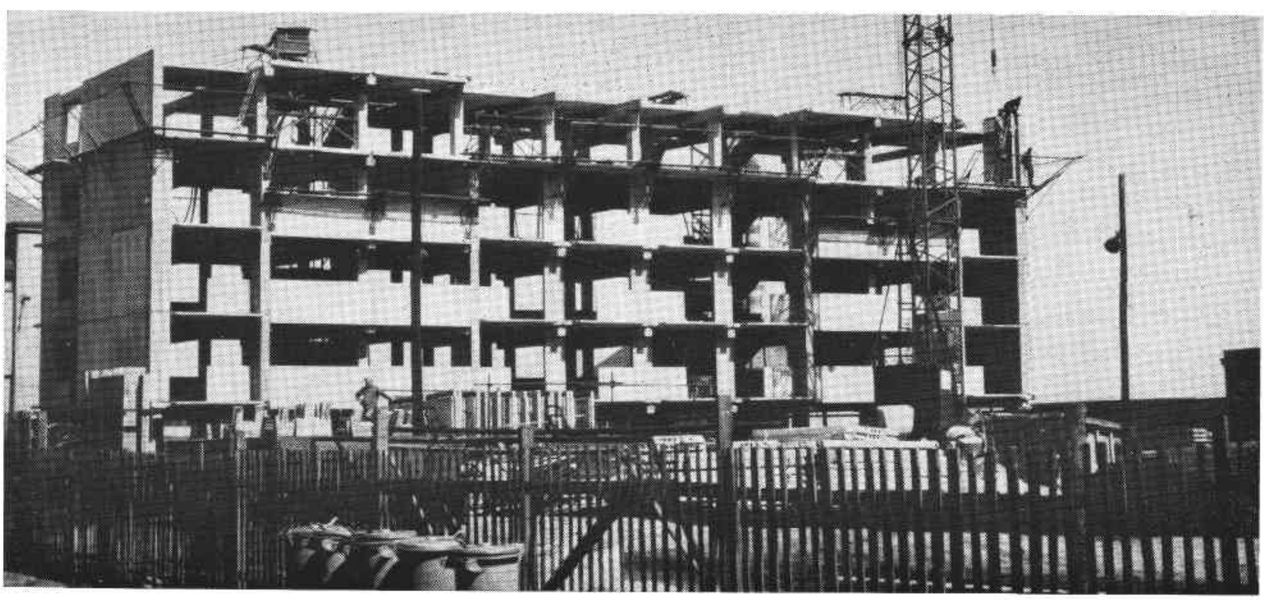


Figure 2 Concrete frames with brick-block partitions and outer wall panels. (Czechoslovakia)

System building, it was thought at Prague, permits more effective use of mechanization and prefabrication in construction, with a consequent reduction in labour requirements and an increase in productivity. A major difficulty, however, is that of organizing demand. Producers need to be assured of orders large enough to provide sufficient continuity of production to justify the substantial capital investment involved in providing the necessary plant and organization. A number of systems based on large panel components require orders of 500 to 1,000 repetitive dwellings a year within a radius of about 100 miles for economic production. This explains in part why such system building, although highly developed in some parts of Eastern Europe, is still quite limited in the West. Although all governments are in general agreement that they should accept responsibility for creating the financial and administrative conditions needed to encourage industrialization, they differ considerably in individual approach.

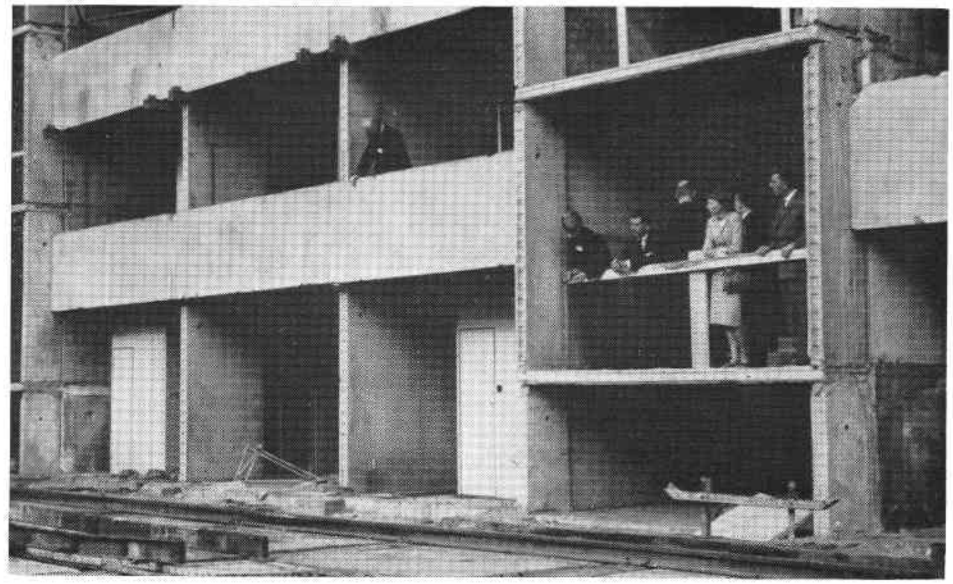
The Eastern European countries, for example, are generally committed to a technology based on heavy concrete panel construction. Probably the most extreme example of this is the production of multi-storey flats in the U.S.S.R.; each flat is made up of a series of concrete boxes, each box factory-fabricated with all interior fittings, services and fixtures, and with floor and wall surfaces completely finished. These units weigh as much as 25 tons and are erected by portal cranes. The total labour content is stated to be 50 per cent less than for traditional construction, although the system apparently requires a degree of uniformity in design that is unlikely to receive acceptance in the West. Other countries in Eastern Europe have not yet reached this stage of development, but all appear to be working towards adoption of the large panel system.

The building industry appears to be at present in an interesting state of transition. In Czechoslovakia one can see under construction buildings representing various stages of evolution ranging from the use of bricks and brick blocks (*Fig. 1*), through precast concrete frames combined with brick blocks and outer wall panels (*Fig. 2*), to transverse bearing walls of both *in situ* and precast concrete with precast floor and outer wall panels erected by tower cranes (*Fig. 3*).

In a new housing development at Mlada Boleslav, a town about 30 miles northeast of Prague where a large Skoda automobile factory is located, construction using the precast concrete frame and panel system was examined (*Fig. 2*). The columns, beams and floor panels were obtained from a central factory, but the non-load-bearing exterior wall panels were made locally in a temporary factory at the site. These particular buildings, which are from four to twelve storeys in height and provide good but modest accommodation, were based on standard plans and built from standard sized elements limited to the following variations: one type of column, four types of beams, ten types of floor panels and nineteen types of exterior wall panels. Bricks and brick blocks were used for the separating interior partitions and all surfaces including panels were liberally treated with plaster to provide a satisfactory standard of finish.

This last aspect is in marked contrast with the approach observed in Sweden in 1963 when it was pointed out that one of the key factors in obtaining economical concrete panel systems is the elimination of site plastering. This is achieved in the Scandinavian systems by using machined steel moulds to produce panel surfaces sufficiently smooth for direct papering or painting. One of the important aspects of any industrialized system is the extent to which it reduces the on-site time of the finishing and servicing trades; in traditional construction this can amount to about one-half of the total.

A further economic consideration is the effect of restricting the available sizes of components in a building in order to reduce production costs. Any savings attained by this means must be balanced against the added costs of over-design that inevitably occur when such units must be used for a wide variety of service conditions. An obvious case occurs with columns in the building just described where only one type of column is produced to support all floors. The extent of standardization achieved by some panel systems is considerable. The "Bison" system, for example,



Cross bearing walls of precast concrete with precast floor and outer wall panels. (Czechoslovakia)

Figure 3

which was developed in Britain using large concrete panels, requires only 21 different components for the construction of tower blocks up to twenty storeys in height.

In Western Europe the development of large concrete panel systems has been generally confined to France and Sweden where they account for about 15 per cent of all housing and are claimed to have achieved increases in productivity of 30 to 40 per cent over traditional methods. In Sweden, where the system of state aid to house building encompasses 95 per cent of the entire housing production, the building industry is organized primarily in large groups. The large contracting firms and the fact that most housing is in the form of blocks of flats or terraced houses has fostered the introduction of system building. Futhermore, the local authorities have been given powers of purchase and sale of land to facilitate comprehensive redevelopment and a regular flow of work adjusted to the capacity of the industry.

In France, where 90 per cent of all house construction is state aided in some form, two major influences have been at work. The first was the stimulus given by direct government encouragement of designers and contractors in the ten years following the war to develop new methods of house construction that would reduce construction labour requirements. The second was the establishment, within the Centre Scientifique et Technique du Bâtiment, of the French "Agrément" system, which provides on a nationally accepted basis a means of assessing the merits of new materials, systems and components.

Somewhat similar to Central Mortgage and Housing Corporation's acceptance procedures for products used in National Housing Act housing, the Agrément system owes its existence to the fact that under French law both architects and contractors have much more clearly defined legal responsibilities for their completed buildings than in this country. Reports of architects and contractors having to pay heavy damages for building failures occur from time to time. In one recent case both architect and contractor were sent to prison for manslaughter on the grounds that an incorrectly installed gas water heater had asphyxiated the occupant of a flat.

This legal situation has led to insurance by the architect and contractor against risks, with the insurance companies relying on the Agrément system for evidence that the structure, materials and components are sound. Approvals are granted for periods of up to three years, and once obtained greatly aid the developer of new building systems in obtaining acceptance by designers, financing institutions and building regulatory bodies. This type of system, which is now being extended to other European countries is considered by many to be an essential feature in accelerating the acceptance of worthwhile innovations in building.

The various conditions outlined have had much to do with development on the Continent of a number of proprietary building systems (known generally by the name of the developer, such as Camus, Coignet, Cauvet, Sectra, Larsen-Nielsen, Ohlsson-Skarne), all of which use concrete as the principal material in panel form. An example of the last named system is illustrated in *Figures 4, 5, and 6*. Technically they represent a considerable advance in concrete technology, utilizing standard components based on repetitive elements; rapid methods of concrete curing; single-thickness exterior walls of high thermal insulation; and excellent factory finishes both externally and internally.

CLOSED VERSUS OPEN SYSTEMS

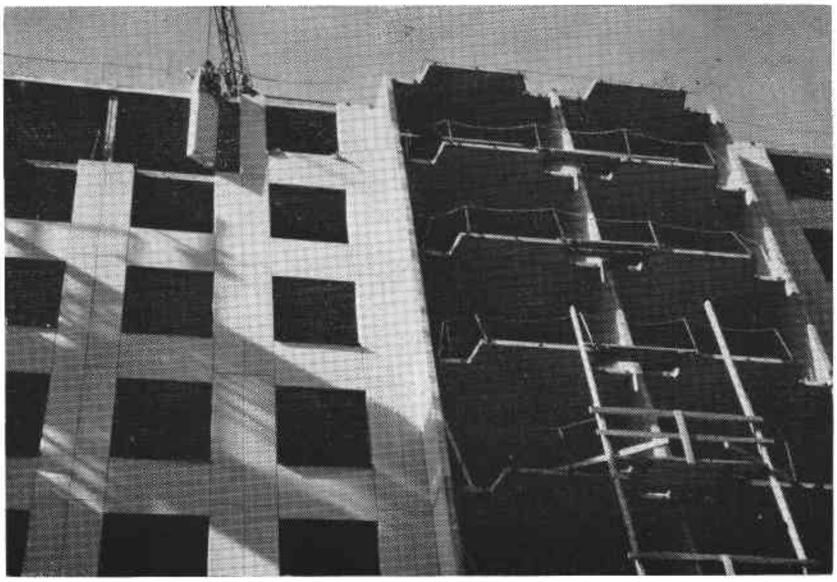
The advances achieved to date have been obtained through the development of so-called closed systems —systems requiring a strict unity of approach throughout the phases of design, fabrication, transport and assembly of components. Some concern has been expressed over the lack of architectural freedom of design that would result from the continued use of such systems, but system building has no monopoly on monotony and the lack of architectural merit in industrially produced housing may well be the fault of the architect rather than the process. Certainly some of the architecture based on these systems is of high quality (*Fig. 7 and 8*), although one can also point to many system buildings that are unattractive (*Fig. 9*), due in part to restriction of plan types. This has led many Western European countries, Britain in particular, to place less emphasis on the large concrete panel systems and to favour instead the development of 'open' systems involving the production of increasingly complex components and elements capable of being assembled in a wide variety of combinations. Such systems, it is thought, would offer the designer a freedom he enjoys at present only with conventional methods and would allow economies of building with standard components.

It is thought that this could best be achieved with a light technology based on metals, plastics and timber rather than on heavy concrete panel construction. Ideally this would lead to the 'catalogue' production by different manufacturers of a wide range of standardized components closely related to one another in terms of dimensions, so that they would be completely interchangeable and require little or no adjustment in site assembly. There are inherent difficulties with this, however, that warrant closer examination.

As a first requirement in this process it is necessary to establish a commonly accepted system of dimensional coordination. The British have attempted this by publishing a guide to "Dimensions and Components for Housing" (*Design Bulletin No. 8, Ministry of Housing and Local Government*), which sets out recommended floor to ceiling heights and suggests a scheme of preferred dimensions for standardizing components to be used when building houses and flats by industrialized methods. The bulletin points out that it is only necessary to control dimensions that affect the relationship between one component and another, and recommends standard sizes for such items as precast staircase flights, wall and floor panels, door frames and windows, and prefabricated service core or 'heart' units.

Much has been said in recent years on the subject of modular coordination and the establishment of 4 in. and 10 cm, respectively, as the basic modules in the English and the metric systems. It is of interest to note the difficulties that arise from treating the 4 in. and 10 cm module as equivalent in establishing standard multiple dimensions for open systems. The small initial differences that exist become much greater and more significant with the larger multiples. The fact that 100 cm is not 40 in. but 39.37 in. and that 40 in. is not 100 cm but 101.60 cm poses serious problems for interchangeable components when they must be manufactured to very close tolerances and advances one further argument for general adoption of the metric system.

How far this 'open' system approach can be carried in practice is difficult to predict. One of the main problems is that the degree of standardization required for fully developed open systems must go far beyond that of dimension alone and must encompass functional as well as dimensional integration of the selected components. This immediately raises important questions about jointing, which is one of the greatest economic and technical difficulties faced by the designer of 'closed' building systems and can prove even more difficult for the more versatile 'open' systems. Not only is structural stability essential, but appearance, weathertightness, thermal properties,



Placing exterior wall panel.
(Ohlsson-Skarne System)

Figure 5

cost and the speed of erection must also be considered in joint design.

The importance of jointing is well illustrated by the fact that in typical concrete panel systems the average flat can comprise about 500 ft. of joint, with labour and materials for this easily amounting to 10 per cent of the cost of the building shell. It is also significant that the most widely used form of joint in these panel systems is an *in situ* concrete connection. Such jointing is not well suited to fast erection, but is used because of its ability to accommodate inaccuracy in panel manufacture and to facilitate the use of reinforcement in the joint to provide structural continuity. The development of dry jointing methods, which will be required if complete interchangeability of components is to be achieved, poses even more difficult problems and presents one of the main technical challenges for the future of such systems.

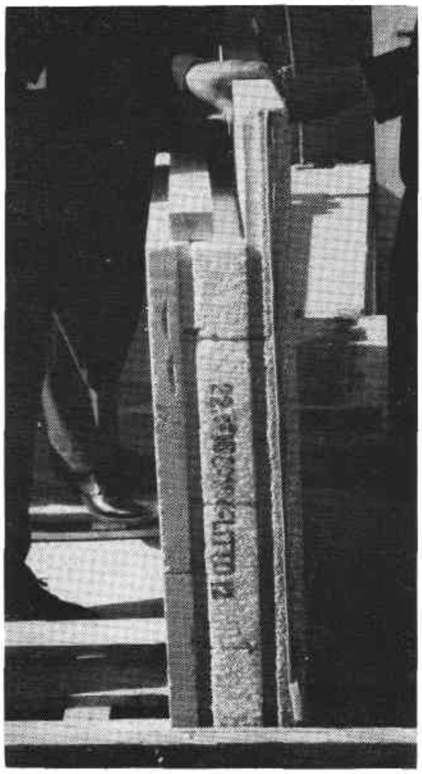
MODERN EUROPEAN PRACTICE

In the meantime developments in system building in Europe continue to take the form of 'closed' systems. These can be classified broadly into two categories. The first comprises systems for high blocks of flats, which will probably continue to be dominated by precast concrete systems of the type developed on the Continent. The second category encompasses systems suitable for low level buildings of two to four storeys that can give densities intermediate between single family housing and high rise apartments.

There is much questioning in Western Europe today of the sociological effects of high flats and a corresponding interest in the development of systems for low buildings. This is particularly true in Britain, where the government's housing advisers have stated that they do not want to see the proportion of high rise building increase much beyond its present level of 20 per cent of public sector housing, and are actively encouraging development of systems for houses and low rise buildings that can provide densities of 80 to 100 persons per acre.

The problem is a challenging one, particularly when considered in terms of the variety of building plans such systems may be required to fit if the choice of building types now available in countries such as Britain is to be maintained. A point not always recognized is the extent to which some of the Continental countries have relied in the past on a limited choice of plan types for dwellings. This restriction on building type, coupled with the ability to organize demand and consequently to achieve a high degree of technical continuity of production has greatly favoured the development of system building. But when this approach is combined with the centralized planning of Eastern Europe there is a risk of imposing too great a rigidity on design.

This was very apparent in Czechoslovakia where the development of system building follows a prescribed pattern. The period between the first experimental stage and the actual construction of buildings is at least five years. The first stage is devoted to research and study. Next comes the experimental design and construction of structures to confirm the findings of research. The third stage is the preparation of a series of standard designs that will become the



Exterior wall panel of foamed concrete and 4 inches of Polystyrene insulation and left, (Fig. 4) a nine-storey apartment near Stockholm—both using Ohlsson-Skarne System.

Figure 6

approved types for a given period. Finally, dwellings are constructed according to these types. The whole process demands considerable foresight and places a high degree of responsibility on all concerned, because the designs, once approved, are built in great numbers throughout the country.

The Western European countries, on the other hand,—notably Britain—have greater flexibility in their approach to design production and assembly, but they have difficulty in organizing the demand required for economic production. In Britain today there are over 250 systems already existing or in the course of development. With so many available it is difficult for any one of them to obtain the continuity of orders required and the over-all effect is to keep costs up, so that full economic advantage of system construction is not realized.

One possible solution, which allows standardization and still permits competition is to encourage the development of what might be called partially 'open' systems within which a range of components or elemental designs are established and from which a variety of plan types, elevation treatments, and building groupings can be achieved. An interesting example of this type of development has been under way in England for school buildings within the group known as CLASP (*Consortium of Local Authorities Special Program*).

CLASP comprises a group of local authorities who studied the detailed requirements for schools in order to develop systems suitable for their combined needs based on common dimensional standards and the bulk ordering of such standardized components as columns, beams, wall units, windows and heating systems. Each of the authorities retains an architect to design individual schools, but the standard components for all are ordered from a central point to obtain the economies of mass production and bulk buying. By this system erection times were reduced 20 per cent over traditional construction and costs lowered 10 per cent on the national average for primary schools.

The CLASP system approach is now being encouraged by the British Government for housing, and a number of housing authorities have formed consortia to develop and use industrialized systems of this type. In this way the 'component approach' or the design and fabrication of components that can be used to provide more flexibility in building systems is making some headway.

A similar attempt, and one that may point the way to use of the system building concept under market conditions in North America, is the SCSD program (*School Construction Systems Development*) now under way in California. In this program thirteen school districts agreed to commit a substantial part of their school building program to a professional team who have developed a building system designed around an integrated group of construction components. The team first prepared performance type specifications that met the educator's requirements yet left the component fabricators some freedom for innovation. It encouraged product manufacturers to participate in the project, reviewed their preliminary designs and finally recommended consortia of manufacturers whose designs seemed most compatible.

To be really effective this method should be confined to buildings with the same functional requirements. Schools are an obvious choice. The mass housing market is another possibility, and it may well be that some such approach should be adopted, at least for the one million public housing units that will be required according to Professor Murray, in his recent report, "Good Housing for Canadians," between now and 1980 if our burgeoning low income housing needs are to be met.

WHAT OF THE FUTURE

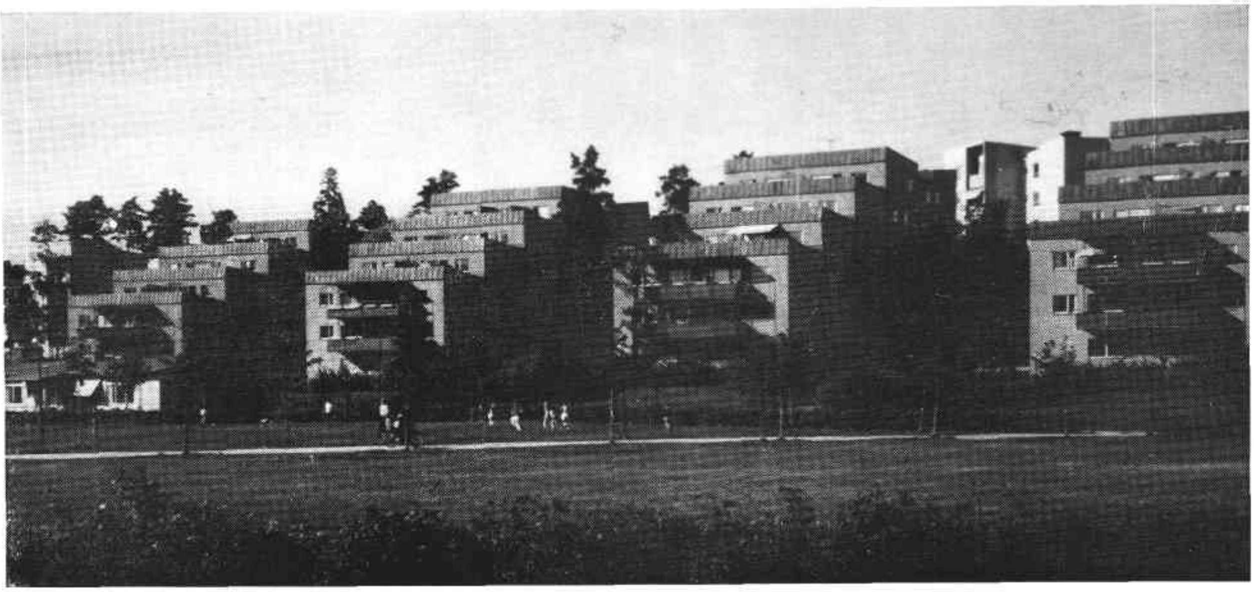
Whether this approach and the general philosophy of system building will receive wider acceptance is difficult to predict. One of the main problems is coordination of client demand. As was seen in Prague, system building has made its greatest advances in areas of strong government participation where demand, and thus continuity of production, can be well organized. Even in countries such as Britain where government is taking a much more active and direct role in building than it does in this country (though less than in many Continental countries) it has proved difficult.

Another important consideration is the effect of industrialized systems on the existing pattern of relationships between members of the building team. What changes are required in the present roles of these members to realize the full advantages of industrialized systems? The Prague Seminar spent much time considering this aspect and suggested that one of the basic needs was for improved communication within the industry. This is made particularly acute by the trend towards more specialized production and the growing number of specialized contractors and is likely to prove an increasing problem in future building whether systems are used or not.

Figure 7

Many consider that the most urgent need for improved communication is between the designer and the builder, because the architect's traditional role as client's representative does not lead to a close relationship between design and production. One method of achieving this is to include the builder in the team at the design stage by means of the negotiated contract. This has the advantage of making his technical experience available when vital decisions are being made and this type of contract is receiving increasing acceptance among architects and clients in Europe. An alternative approach is the so-called 'package deal', where the contractor employs the architect and offers design services combined with construction.

Both methods can be questioned on the grounds that they interfere with the customary approach to competitive tendering. Regardless of the approach, however, designers need to be provided with more systematic knowledge of construction methods and wherever possible the design, manufacture and



System Building for high and low blocks can be varied and attractive . . . *Figure 8*

. . . it can also be plain and institutionalized.

Figure 9

assembly of building components should be more closely integrated if industrial systems are to make their maximum contribution. Combined with this must be a careful and continuing analysis of user requirements.

It is worth noting that in most other industries the innovators are the professionals responsible for the ultimate performance of the end product. In construction the opposite is true. The professional practitioner is often too small to support the necessary research and such innovations as do occur are generally initiated by product manufacturers working alone. There is room for a more coordinated approach and one of the conference recommendations affecting market economy countries was that government groups concerned with research and design should be allowed, and indeed encouraged, to participate actively in development programs. In this connection it was recognized that the pace of development depends to a great extent on the time lag between research and its application, and this in turn is conditioned by the efficiency of transmission of knowledge and by the availability of information. The value of such international organizations as the International Council for Building Research Studies and Documentation (CIB) as a continuing source of objective and balanced information was stressed throughout the conference discussions.

We must not lose sight of the fact that industrialized building, as was stated in the introduction to this paper, is much more than system building, and includes in its most complete sense the application of industrial methods to all phases of the building process, whether traditional or non-traditional. Industrialization is characterized in both cases by a shift from manual work to machines, from work on site to work in factories, and from piece production to serial production; perhaps most important of all, it is characterized by a high degree of organization of the building process.

The development of wood frame construction in Canada illustrates the considerable gains in productivity that can be achieved by the industrialization of traditional methods. The man-hour requirements of a typical frame dwelling, excluding foundations, have been reduced from 1200 or more to as low as 600 by organizing the entire process around plant assembly of the basic shell (*see*, *Prefabrication in Canadian Housing, by R. E. Platts, National Research Council, Division of Building Research, NRC 7856, March 1964*). The factory portion or 'shop-content' of these typical prefabs, which currently comprise about 15 per cent of Canada's yearly production of single-family dwellings, is only 15 to 30 per cent of total labour, but even this slight shift from the site to the shop has greatly aided in rationalizing the building process.

Much can still be accomplished, as is evident from a recent study of manpower utilization within the Canadian construction industry carried out by Professor Aird of the University of British Columbia and published by the Division of Building Research. The fast-rising demand for housing in Canada (one recent estimate suggests a need for four million additional units by 1980) will make building productivity an even more vital consideration in this country in the years ahead.

Wood frame construction will no doubt continue to receive wide use and will remain a most difficult yardstick of cost and quality against which proposed innovations must be measured. Wood frame construction is not, however, readily amenable to highly mechanized processes, and it may well be challenged by systems favouring optimum machine production, such as those incorporating plastic sandwich components or plastic-bonded wood fibre materials. These have already undergone considerable development and appear quite promising for low buildings. If current trends to multi-family dwellings continue, and particularly if these take the form of high rise construction, we can expect increased interest in concrete panel systems of the type developed in Europe. The future of such systems will depend not only on their ability to provide technical adequacy and satisfactory appearance at reasonable cost, but also, and this is a most important consideration, on the extent to which they are able to overcome local prejudice and outmoded building codes.

Whatever the outcome, there is little doubt that the future will present many challenges and that much benefit can be derived from a continuing exchange of views and experiences. Above all we must not forget that buildings are for people, and we must not allow the technical and organizational problems to overshadow the social implications of what is being done. As Sir Winston Churchill has so aptly pointed out: "We shape our buildings and our buildings shape us."

H. Brian Dickens was born in Toronto, Ontario, and had his early education in England. Following three years of service with the R.C.A.F. from 1942 to 1945, he attended the University of Toronto, graduating in 1950 with the degree of B.Sc. in Civil Engineering. In May of that year, he joined the staff of the Division of Building Research of the National Research Council in Ottawa. He has worked with the Housing Section, apart from a three year period (1957 to 1960) when he was in charge of the Division's Northern studies. Since 1960 he has been Head of the Housing Section and in this capacity he works very closely with the Central Mortgage and Housing Corporation. He is a member of the Association of Professional Engineers of Ontario.