PREFABRICATION IN 20TH CENTURY BRITISH HOUSING

"PREFABRICATION IN 20th CENTURY BRITISH HOUSING"

Jon Risdon

Construction III

INTRODUCTION

As with any industry, development and improvement, of necessity, takes place, to which rule the Building Industry, as one of the main world industries, if not the largest, is no exception. The industrialisation of building has been a very long and gradual evolutionary process and it has only been within the last hundred years that the industry has achieved more than a superficial level of industrialisation. Whereas, before now, the demand for more sophisticated industrial techniques was present and we did not yet possess the wherewithall (although the situation was obviously not so clearly defined as that - we were bound to design and build using accepted techniques and materials to a great extent), we now possess the technology but we have only had a mere twenty years in which to use it before National and world economy has militated against its wide spread use: in effect, we can't afford to save time. Encouraging investment in large-scale industrialised projects is so difficult, that the process of building has undergone a reverse in direction: apparently "we are riding into the future with our eyes on the rear-view mirror" (quote by Marshall McLuhan), but according to some, including Richard Bender (A crack in the Rear-view Mirror, Richard Bender, 1973, Van Nostrand Reinhold), there is now a crack in this mirror. The trouble with the Building Industry is that it is so easily affected by the economic situation that one could very easily look forward to a rosy future of a highly productive mechanised and industrialised Building Industry in and after a building boom such as we saw in Britain (and Germany) in the late fifties because of:

(a) our recovery from the shortages of materials and labour of the immediate post-war years

(b) financial aid from America

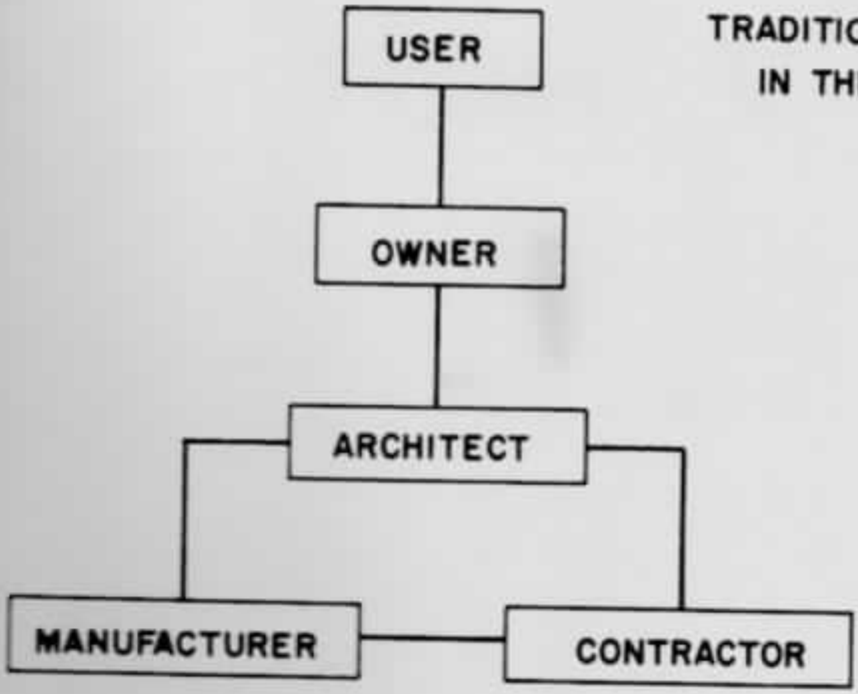
(c) pooling of military resources (Germany of course could afford to spend more on new housing construction after the war with an almost non-existent defence budget).

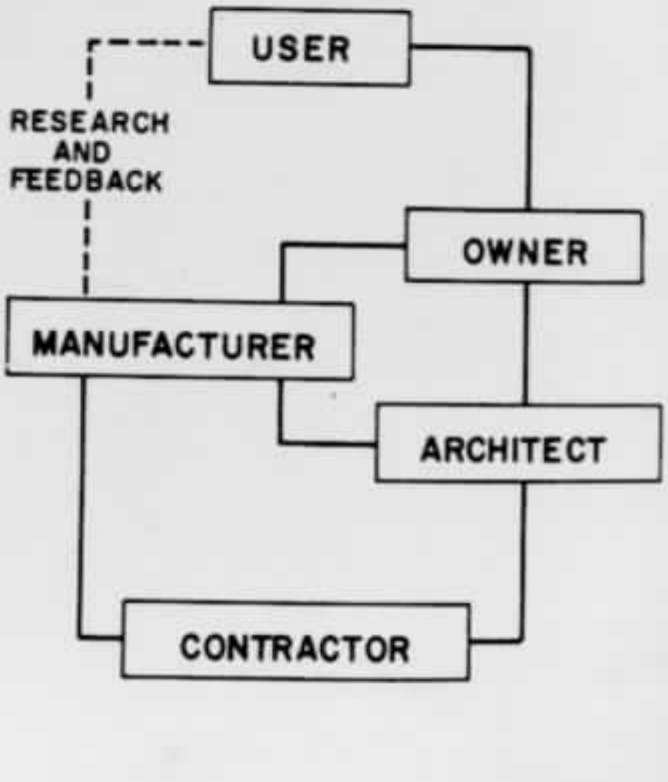
More housing was privately built in the 1958-66 period and there was an expansion in the finance facility; this period of "housing affluence" ("Architecture versus Housing", Martin Pawley, Praeger, 1971) saw significant changes in financing, planning, design and density and a change in housing attitudes generally.

This report is not intended to be purely a technical description of all the available types and methods of prefabrication, but a broad view of the twentieth century situation as a whole, encompassing the political, social and technical aspects of the industry, and the course of its development. As I have already stated, prefabrication as a process and a philosophy has not been arrived at just by conscious decisions - the industry has developed very gradually almost since building began and innovations have been introduced to fulfill the needs of industrial development (and profit) catering for the mass housing market. A forerunner of prefabrication as an element of the industrialised building process generally was standardisation, which will be enlarged upon in the text.

Prefabrication has been variously defined since its beginning as a concept, so rather than bewildering the reader with a vast number of definitions, a few concise summations will suffice here to help the reader become clear in his mind as to what he is actually reading about.

TRADITIONAL RELATIONSHIPS
IN THE BUILDING PROCESS





EVOLVING RELATIONSHIPS
IN THE BUILDING PROCESS

Fig. 1

The RIBA defined the industrialisation of building in a 1963 report as "The organisation of building industrially by applying the best methods and techniques to the integrated process of demand and design, manufacture and construction" ("The Industrialisation of Building" RIBA, April 1965) and the report made several recommendations as to how the process of industrialisation could be helped, a few of which I will include in the text as and where necessary. The improvement of integration in the building process is a factor which will recur in the text several times. Most of the information I have been able to collect is a good deal out of date (in the terms of our present fluctuating economic climate) so most statistics and recommendations must be seen in that context.

An American view of prefabrication was: "It is a question of degree. To over-simplify, if you SHOVE and SNAP a product into place in the field, that's prefabrication. If you mix, cut, spread, fix and patch, that's not prefabrication. If the field operation be essentially assembly, rather than manufacture, you have prefabrication..... The amount of scrap and waste that must be cleared up and removed from a building site may be taken as a rough index of the degree of prefabrication employed in any given building operation, since waste results mainly from a manufacturing process, not an assembly process" (Prefabrication - What does it mean to the Architect. Howard T. Fisher, Journal to American Institute of Architects, Nov. 1948).

In Great Britain, prefabrication for its own sake has seldom been consciously aimed at. Although never fostered in the interest of a long-term housing policy, it was given its major impetus through the unhappy accident of two major wars, when almost any house at any cost was acceptable as long as it was a functional proposition and it could provide "a reasonable substitute for conventional materials and labour that were temporarily scarce" ("Prefabrication - a History of its development in Great Britain". National Building Studies - Special Report 36. HMSO 1965). It seems quite clear that it was not at any time the policy of any of the successive Governments to take all housing out of traditional builder's hands - public opinion would have reacted unfavourably to such a move because among many Local Authorities there was a lingering memory of some of the ill-conceived houses with which they had been saddled after the first war, and for the maintenance of which some had paid rather heavily.

The National Building Agency, whose inception was welcomed by the RIBA in their 1963 Report, is "an independent advisory body, whose main functions are to promote the use of improved techniques of design, management and site operations. It provides services to public authorities, the voluntary housing movement and their professional advisers, as well as to building contractors and manufacturers". (Quote from letter from RIBA Librarian). In an advisory capacity, the NBA publishes reports every so often similarly to the Government sponsored Building Research Station's special reports and National Building Studies (of which the abovementioned book "Prefabrication - a History of its development in Great Britain", is one. At the "Eurofab Congress" in Paris in April 1975, a paper entitled "Is open industrialisation a myth" was presented by Mr. Cleeve Barr, Managing Director of the NBA. I think it is worth extracting a fair amount of information from this report, mainly because it is so recent, but also it is so concise - of necessity a conference paper has to be

Royal Institute of British Architects
66 Portland Place
London W1

19 January 1976

Dear Sirs

I am a third year student at Bristol Polytechnic and I am writing my thesis on 'Prefabrication in Building'. I have read your 1964 report Sfb B96 'The Industrialisation of Building' and I would be interested to know if this has been updated. If this is not so, I wonder if you could give me a brief summary of recent trends in this field, also the present state, if any, of the National Building Agency.

Yours faithfully

Jon Risdon

Jon Risdon
3rd year student
Department of Design
School of Construction

Royal Institute of British Architects 66 Portland Place London W1N 4AD ☎ 01-580 5533

RHK/JHC 27th January 1976

Mr.J.Risdon,
Department of Design, School of Construction,
Bristol Polytechnic, Clanage Road,
Bower Ashton, Bristol BS3 2JU

Dear Mr. Risdon,

Thank you for your letter of 19th January. The 1965 RIBA publication, The industrialisation of building, has not been updated, although the RIBA and the National Building Agency were jointly responsible for a conference in January 1967 entitled, Industrialised housing and the architect, papers from which have been published. May I also recommend the NBA.'s Industrialised two-storey housing, London 1970, and an American book, BENDER, R. A Crack in the rear-view mirror: a view of industrialised building, New York: Van Nostrand 1973. I am enclosing a photocopy of the bibliography from this book, which I hope you will find useful.

The National Building Agency (National Building Agency House, Arundel Street, London WC2) is, "an independent advisory body whose main functions are to promote the use of improved techniques of design, management and site operations. It provides services to public authorities, the voluntary housing movement and their professional advisers, as well as to building contractors and manufacturers." You may also be interested to know of the existence of the Association of Industrialised Building Component Manufacturers Ltd., 26, Store Street, London WC1.

Yours sincerely,

RHKa

R.H.Kamen,
Library.

enc.

to the point.

"Open industrialisation means the manufacture, distribution and use on building sites of ranges of standard components produced by advanced factory processes which also permit freedom and flexibility in design to individual architects. As a design philosophy it is more easily applied to non-structural than to structural components. The design flexibility in open industrialisation is not as great as with traditional building because the size of units is generally larger and they tend to conform to some pattern of dimensional co-ordination". This flexibility in design using standard details was previously stated in the 1963 RIBA report - although it might seem like a contradiction in terms, the more standard details there are to be included in the design of a project or group of projects, the greater freedom the architect has working within those parameters.

"The concept of open industrialisation has grown up in Britain, partly as a result of natural evolution in the processes used in the manufacture of building products, and partly by the design of new components for client-based consortia or programmes of building in the public sector. The significance of the evolutionary approach is often overlooked by some of the theorists in public offices who wish to start every new system de novo." There have in recent years been several successful examples of the evolutionary development of "open" components by industry itself, including:

(a) Roof trusses - they presently occupy 90% of the market

(b) Flush doors and door sets - most doors are produced by half-a-dozen leading firms

(c) Windows and non-structural cladding units

TYPE OF HOUSE	OFF-SITE WORK	ON-SITE WORK
LOG CABIN 		- FELL TREES - SHAPE AND FIT LOGS - HEW PLANKS FOR ROOF, FLOOR, FURNITURE, ETC.
EARLY BALLOON FRAME 	- MILL LUMBER - PRODUCE HARDWARE AND PAINT - FACTORY-MAKE FURNITURE	- CUT AND FIT LUMBER FOR FRAMING, SIDING, ETC. - CONSTRUCT WINDOWS, DOORS, STAIRS, CABINETS - PLASTER - PAINT AND FINISH
CONVENTIONAL FRAME 	- MILL LUMBER - PRODUCE HARDWARE AND PAINT - FACTORY-MAKE FURNITURE, CABINETRY, WINDOWS, DOORS, STAIRS, WALLBOARD	- CUT AND FIT LUMBER FOR STRUCTURE AND CLOSURE - INSTALL FACTORY-MADE COMPONENTS - PAINT AND FINISH
PACKAGE HOME 	- DESIGN AND FABRICATE A SET OF COORDINATED BUILDING COMPONENTS FOR STRUCTURE/CLOSURE, PLUMBING CORES, WINDOWS, DOORS, INTERIOR DIVIDERS AND STORAGE UNITS	- ASSEMBLE PREFABRICATED COMPONENTS
MOBILE OR SECTIONAL HOME 	- FABRICATE COMPLETE FACTORY-MADE HOUSE WITH ALL FINISHES AND APPOINTMENTS	

Fig. 2: Evolution of American dwelling types

(d) Partition systems.

(e) Kitchen and other standard storage units.

(f) Structural wall and floor units for house construction. Prefabricated timber systems for house construction are now becoming widely used in Britain for both public sector and private house building. (see letter from Bristol City Planning Department dated 27th January).

(g) Plumbing units.

(h) Sanitary units (packaged bathroom units). Complete for building in or onto a house improvement or extension - this is a development which conserves existing material resources (see letter from Architectural Association, Chapter 4).

(i) Electrical Services Package, Heating Systems, Ceiling Lighting, Heating and Ventilation Systems.

(j) Precast Concrete, GRP, GRC and other cladding systems

The development of open industrialisation has been supplemented by the development of components as parts of "light-weight building systems which have succeeded in aggregating the necessary markets to justify factory production and whose components may be used over a wide range of building designs" and this process could be called "The Systems Approach". The comment on "the necessary markets to justify factory production" is another factor that is emphasised over and over again - building projects, especially in the public sector, should be either made large enough or be grouped together to facilitate:

(1) Standardisation of details

(2) Continuity of ordering and production of components, allowing the manufacturer to invest in new machinery, organise production and reduce the unit price of components

Director of Housing
Avon County Council
The Council House
College Green
Bristol 1

20 January 1976

Dear Sir

I am a third year student in the Department of Design, Faculty of Art and Design, and I am writing my thesis on 'Prefabrication in Building'. In connection with this, I wonder if you could tell me:

1 How many prefabricated systems Bristol Corporation uses regularly in the housing field?

2 Has the use of same increased over recent years?

3 Are projects grouped together to enable standardisation of ordering, manufacture and use of components?

4 Does the Corporation employ architects or are projects contracted out?

5 Are there 'Corporation-appointed' contractors or is each project or group of projects put out to competitive tender?

Yours faithfully

Jon Risdon

Jonathan Risdon
3rd Year BA Art and Design

City of Bristol
City Planning Department

J R Preston, RIBA, MRTPI
City Planning Officer
[redacted]

Cabot House
Deanery Road, Bristol BS1 5TZ

Telephone (0272) 26031

When calling or telephoning about this letter please ask for Mr. Shearman *Ext.* 457

Jonathan Risdon Esq.,
Bristol Polytechnic,
Clanage Road,
Bower Ashton,
Bristol.
BS3 2JU

Your ref

Our ref WS/KS/AS

Date 27th January, 1976

Dear Sir,

Your letter of the 20th January, addressed to the Director of Housing has been passed to me for my attention. This Corporation does not normally use any prefabricated system of building although one pilot scheme is currently being carried out to investigate the potentialities of timber in the housing field. Specialists in other systems have from time to time been invited to tender for "package deal" schemes but these have for one reason or another not been suitable for the systems investigated.

I hope this answers your questions satisfactorily.

Yours faithfully,

L. D. Jonas

Assistant City Planning Officer
Architectural Services

(3) revisions as a systematic process of development

(4) appointment of contractors for a given assured quantity of work at a rate and standard previously agreed

(5) more effective and continuous use of site labour

To put prefabrication in its present context, it is worth giving a brief outline history to show the major landmarks which determined its development. The two wars of this century did most to advance prefabrication as a philosophy, but it is well known that great national upheavals do not always provide the best climate for calculated and sober judgements of future trends.

Of course, most people's concept of prefabrication is the thousands of small self-contained dwellings which were produced in and after the second war to overcome a chronic housing shortage (but not much more chronic than it has been before or since) and a shortage of skilled labour. As temporary dwellings, these "prefabs" were very useful, and people did become quite attached to them as they fulfilled the Englishman's dream of owning a "self-contained cottage", but they have certainly outlived their usefulness now, even though a great many still stand (see City Housing Department letter dated 7th April).

As early as 1624, the English settlers took with them to America a "panelised" wooden house, which was subsequently dismantled and reassembled somewhere else several times. Strangely enough, although timber has an inherent aptitude for low technology prefabrication, it was cast iron which was used in a progression from this early timber house during the Industrial Revolution - quite a few prefabricated cast-iron houses were shipped out to the colonies by those who could afford them and merely bolted together on site. As previously stated, post-war prefabrication was not a conscious search for new methods and materials for building new types of houses, but for new methods and materials for building traditional houses and generally "getting back to normal" as soon as possible - in fact, programmes to find alternative methods and materials were curtailed after both wars when building supplies and skilled labour had reverted to something approaching the pre-war level.

Building bye-laws before the first war, although they had little direct effect on the course of building development did influence it indirectly by setting the scene as it were for the advent of standardisation for "it is doubtful if standards, whether resulting from manufacturers agreements or from Government sponsored codes would ever have grown so rapidly but for the revolution in housing initiated by the Local Government Board" (a forerunner to the Ministry of Health, set up in 1871). (Prefabrication, a History of its Development in Great Britain", H.M.S.O.)

Although local bye-laws exist to enforce minimum standards, their existence can hinder innovation, and this was realised in 1906 when a circular was compiled by the Rt. Hon. John Burns, President of the Local Government Board, urging amendment of building bye-laws on commonsense lines to facilitate the building of cheap, but good cottages.

An important step in the assessment of new and untried materials was the formation of the Building Research Board within the Department of Industrial and Scientific Research, culminating in the opening of the Building Research Station, whose present premises are at Garston in

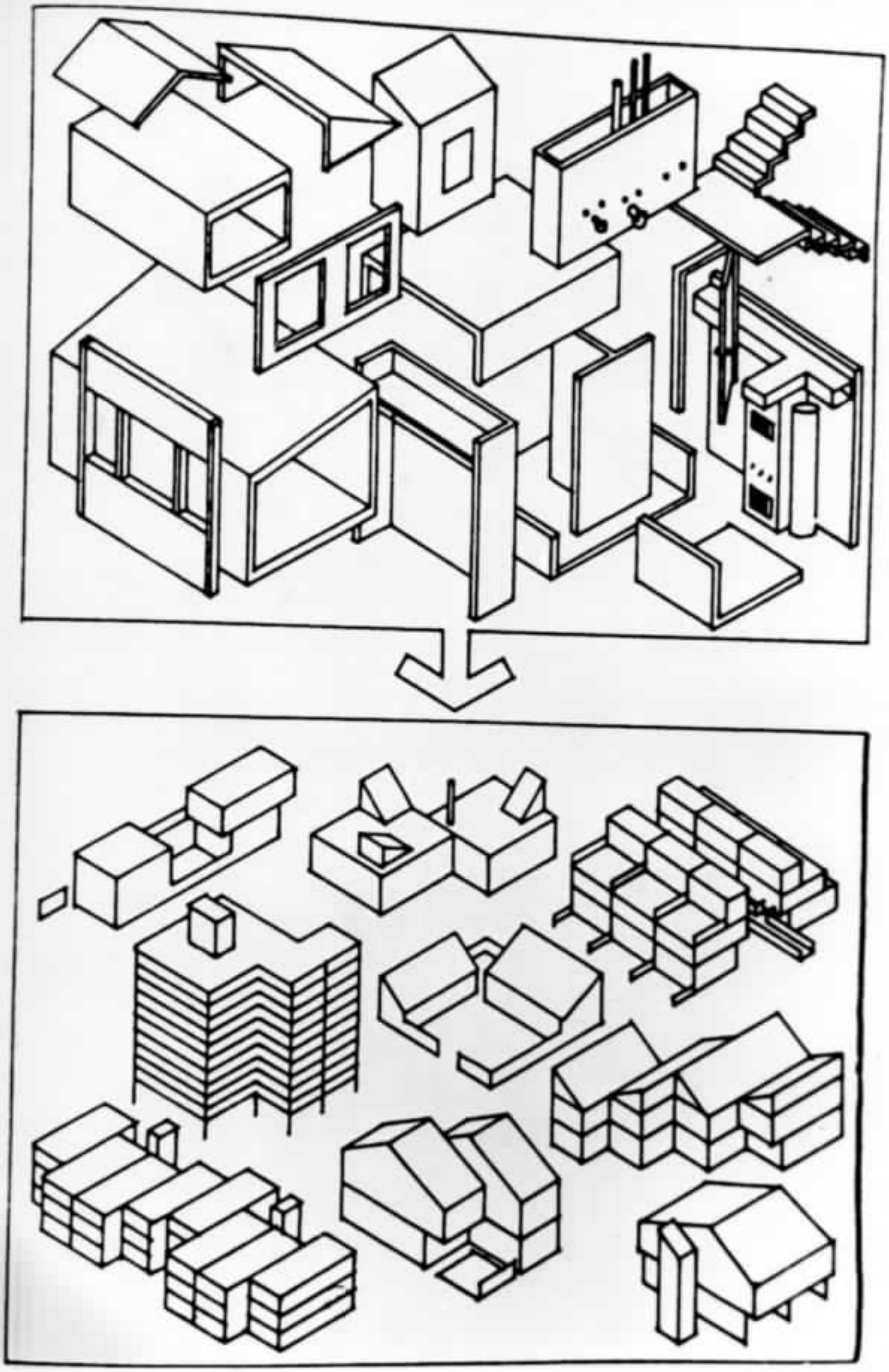


Fig. 3: Possibilities using a kit of parts

Hertfordshire. One of the greatest single inter-war contributions may have been the large-scale manufacture of plasterboard of a much greater size than had hitherto been possible.

A Ministry of Works Committee on Codes of Practice and Standards was convened in August 1942 "To study the application in building of standard plan elements, standard specifications and building components and methods of prefabrication etc.", but it seemed that there was no justification for alternative methods unless they secured improved standards without adding to cost (improved output was no justification). One result of the wartime committees that we have all seen is the "prefab", the design of which came about as a result of collaboration between the manufacturers who made the materials used in their construction - a move which could perhaps benefit the industry again today.

In 1953 "Model Byelaws", from which local byelaws are derived, were passed, allowing buildings to be designed on a structural basis. They need not be restricted to the use of any particular building materials, provided that the structure will carry the loads it will be subjected to, without exceeding the appropriate stress limit and without undue deflection or distortion. Sir Don Gibson was appointed by the Minister of Public Building and Works in 1962 to be Director General of Research and Development to co-ordinate and extend the activities of research and development groups throughout the Government Service. The three main functions of this office were:

(1) To encourage and develop generally the use of new and rapid construction methods.

(2) To standardise the use and production of building components to the greatest extent.

(3) To secure the widest dissemination of the best modern practices.

Whether this department succeeded in its aims is probably a matter for speculation but it is very unlikely that there is a Government Department at the present moment with similar ambitions - it is not impossible that there is a department working on all possible ways of economising within the Building Industry and restricting Public expenditure.

In Chapter one I will set out systems of mass-production that can be and are used: again, some of the processes will have been abandoned or not been taken up at all since the information was published, but it is certainly worth knowing the aims and methods of the manufacturing industry within the last ten years or so.

Chapter I - MATERIALS AND SYSTEMS OF MASS PRODUCTION

As the title suggests, this chapter is to be concerned with the development and use of materials in relation to systems of mass production - it will not necessarily be dealing with the technicalities of individual systems, although certain well known methods of production (rather than 'systems' which suggests proprietary uses of materials and construction methods) will inevitably be touched on in the course of the narrative.

Once again, the point has to be made that prefabrication is only a part, even though it is possibly the greatest part, of the broader spectrum of industrialisation of the industry as a whole. If it seems as though examining only prefabrication is avoiding the issue of industrialisation of the construction industry as a whole, it is, apart from being a subject that could only be given the most superficial of examinations in a document of this length, because such apparently extraneous elements as site plant and investment programmes of industrialised component manufacturers would have to be given much more than the passing reference that they will receive in this examination.

Also again, it would be worth specifying what industrialised building actually is - this time the definition is from the Ministry of Housing and Local Government (DoE) Circular 76/65, which reads as follows:

"The term industrialisation as used here covers all measures needed to enable the industry to work more like a factory industry. For the industry this means not only new materials and construction techniques, the use of dry processes, increased mechanisation of site processes and the manufacture of large components under factory conditions of production and quality control: but also improved management techniques, the correlation of design and production, improved control of the selection and delivery of materials, and better organisation of operations on site. Not least, industrialised building entails training teams to work in an organised fashion on long runs of repetitive work, whether the men are using new skills or old. For this purpose, industrialised building can include schemes using fully rationalised traditional methods".

Although this last comment might seem to be outside the concept of which prefabrication is a part, certainly as far as the Government is concerned, rationalisation of traditional building methods can contribute a great deal towards industrialisation of the building process, and in almost all new buildings, including those using traditional methods of construction, more and more factory made components are being used eg. roof decks, curtain-walling, precast concrete frames or just preparatory drilled or welded steelwork to simplify site construction. The RIBA recognised this recent increased use of factory-made components in Great Britain in their 1963 report.

At this point it seems wise to enlarge upon the various systems of prefabricated construction that are available. The Department of the Environment publishes quarterly "Housing and Construction Statistics" (through HMSO) and in the supplementary tables at the back, they list the industrialised building systems classified by the former Ministry of Housing and Local Government in 1968. The list is based on seven main structural principles, modified in three cases by whether the production of the main structural elements is done on site or in a factory.

These ten main categories may each be subdivided according to the main structural material used. A few dwellings completed in experimental schemes remain unclassified owing to lack of sufficient information.

Rather than list the ten systems mentioned above, I will refer the reader to table XIX of "Housing and Construction Statistics 13" which I have reproduced, but it would be worth enlarging on the actual materials used in these systems. The most obvious material for prefabricated structural frames and non-structural dadding panels is reinforced concrete, which has been used almost continuously since it was first patented by W.B. Wilkinson, a Newcastle Plasterer, in 1854, who embedded a network of flat iron bars or secondhand wire rope in floors or beams (Building in Britain, Normal Davey, 1964). It is possible that some people shudder when they think of reinforced concrete, having visions of the monolithic tower blocks envisaged and constructed by Le Corbusier and others; this, of course, is when concrete is poured in-situ, and it is quite true that the effect can be monolithic, but daddings of any description can be added to improve the appearance of buildings so constructed, and, in my opinion, not enough is made of exposed aggregate and machine-tooled finishes which can substantially enhance the appearance of in-situ concrete. It is quite probable that when poured concrete has been used for large council house projects, it would have negated any saving in labour using this method by tooling the surface or exposing the aggregate, instead of just painting the smooth-faced concrete, as is so in the majority of cases. These alternative finishes are often seen on large office buildings where the appearance of the building is foremost in

XIX Industrialised dwellings completed: by type of structure and main structural material

Local authorities and new towns: England and Wales

Number

	1966	1967	1968	1969	1970	1971	1972	1973	1974
Lightweight loadbearing panel, factory made:									
Concrete	779	791	563	176	124	232	71	84	126
Steel	618	1,032	477	92	7	19	67	59	37
Timber	2,524	3,383	5,825	5,160	6,681	4,380	3,181	2,727	5,995
All materials	3,921	5,206	6,865	5,428	6,812	4,631	3,319	2,870	6,158
Lightweight loadbearing panel, made on site	—	—	—	—	—	—	—	—	—
eavy panel, factory made: Concrete	8,934	11,784	13,461	14,673	16,205	13,155	5,193	3,515	3,821
Heavy panel, made on site: Concrete	2,403	3,092	4,436	6,083	8,361	4,300	2,512	1,124	1,093
Light frame, factory made: Steel	1,402	2,719	2,572	3,002	3,005	1,315	1,325	1,256	1,871
eavy frame, factory made:									
Concrete	277	302	403	646	718	578	228	191	463
Steel	350	8	420	60	—	—	95	—	—
All materials	627	310	823	706	718	578	323	191	463
Heavy frame, made on site: Concrete	346	502	242	128	—	—	—	—	—
ox, factory made:									
Concrete	304	—	126	108	158	—	—	—	—
Timber	21	249	133	29	—	—	—	—	—
All materials	325	249	259	137	158	—	—	—	—
ationalised traditional: Brick	2,443	4,821	6,101	6,874	7,238	5,177	4,112	2,543	1,627
situ concrete	17,058	20,354	15,774	16,138	13,204	9,158	7,773	6,161	9,503
l structural types:									
Concrete	30,101	36,825	35,005	37,932	38,770	27,423	15,777	11,075	15,006
Steel	2,370	3,759	3,469	3,154	3,012	1,334	1,487	1,315	1,908
Timber	2,545	3,632	5,958	5,189	6,681	4,380	3,181	2,727	5,995
Brick	2,443	4,821	6,101	6,874	7,238	5,177	4,112	2,543	1,627
nclassified	35	12	36	1	—	—	—	—	—
tal	37,494	49,049	50,569	53,150	55,701	38,314	24,557	17,660	24,536

the architect's and client's consideration, and, of course, the client can afford the extra labour cost, but it is a pity that most council house tenants have had to put up with the same rather bland finish for the sake of money saved on labour - it would be interesting to compare times for painting and applying (in effect, removing) the alternative finishes.

Another method of using concrete is in a post-and-panel construction or combinations using other materials (eg. steel frame and precast concrete panels, or concrete frame and brick-faced concrete cladding panels, or concrete frame and timber non-structural panels clad with timber or plastics, and this can produce a much more pleasing and variegated result. More recently, concrete has been introduced into the field of plastics for the production of glass reinforced concrete (GRC) non-structural cladding panels, which no doubt reduces the unit price and, even if not improving upon the strength and durability of GRP, certainly maintaining the high standard.

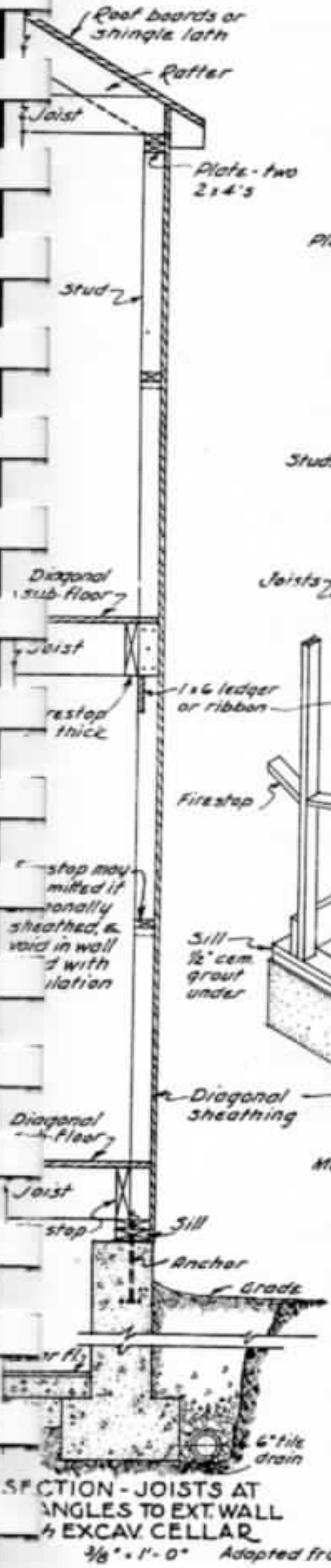
The main advantages of concrete are, of course, that it is cheap and simple to use, and some, at least, of the constituent materials required for concrete are indigenous and in plentiful supply. It is perhaps surprising that concrete has attained such a strong position in the industry over another indigenous material, namely, timber, but knowing the preference of the British for solidity and permanence in dwellings ("an Englishman's home is his castle") it is understandable, especially when seen in conjunction with the advantages mentioned above. In fact, looking at table XIX, although concrete is way ahead of the rest in all structural types, it is only in the use of in-situ concrete that it really takes the lead. In all other systems, panel and frame, concrete is followed fairly closely by timber and steel.

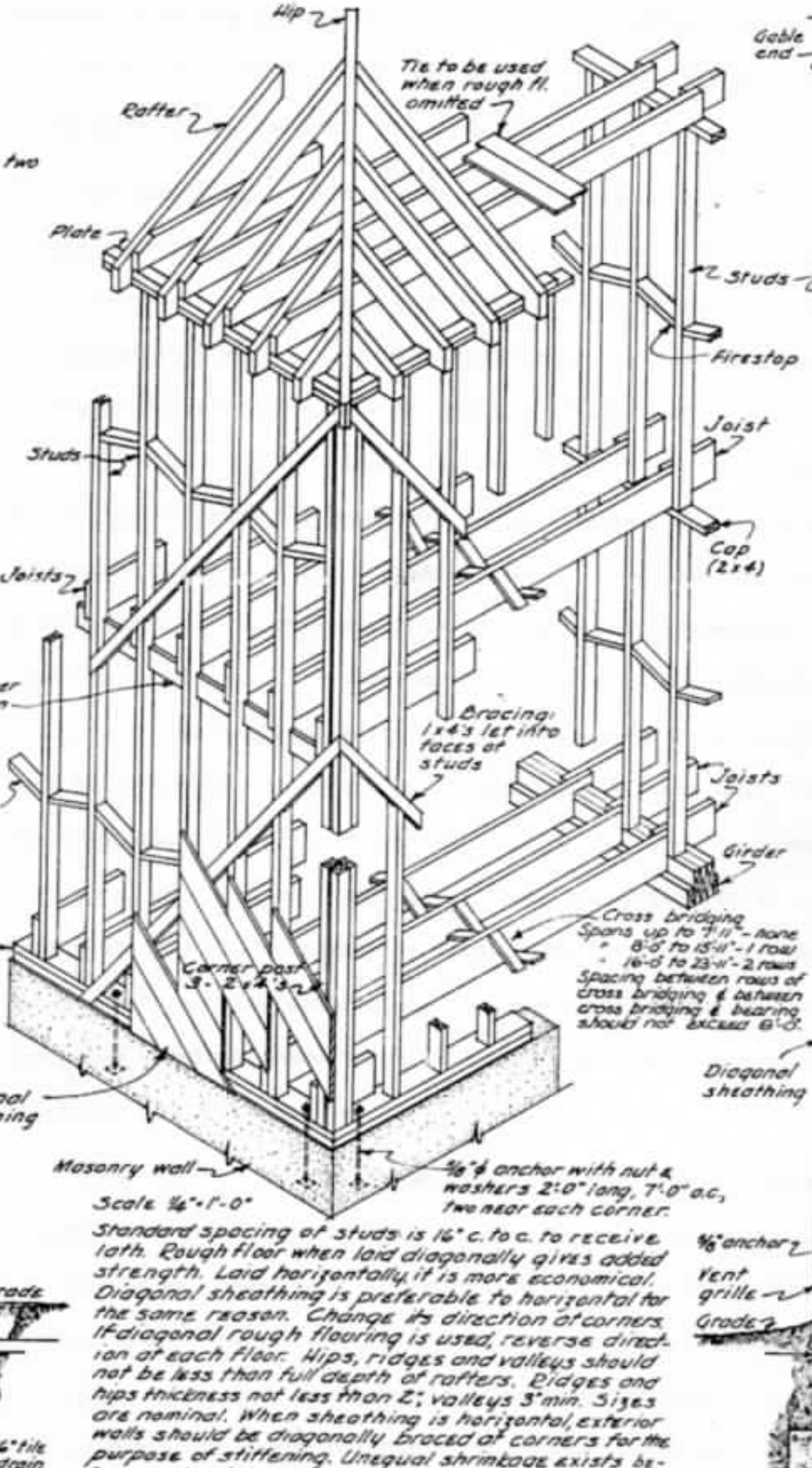
The next material to consider is timber. Judging by the table XIX figures, it is roughly on a par with brick and steel behind concrete in frequency, but its use has fluctuated quite widely sometimes, and, in fact, it is in one of the few systems i.e. factory-made light-weight load-bearing panels, factory-made light steel frames, and factory-made concrete heavy frames that its use has increased since 1966, instead of reduced - notice the drastic fall-off in the use of in-situ concrete.

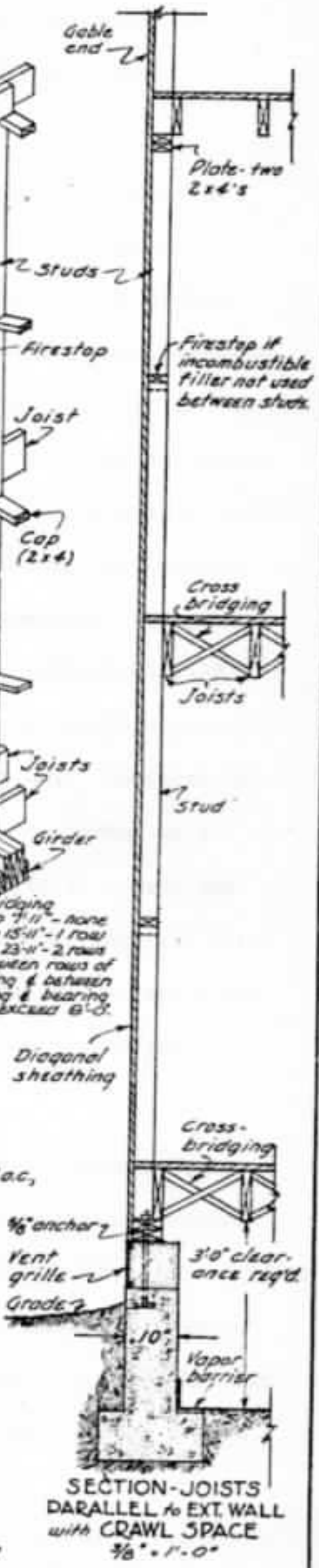
Of course, everyone laments how the price of timber has 'shot up' since 'a few years back' but in fact, although the price has doubled since 1970, that is more or less the same percentage increase as nearly every other building material across the board (only cost prices are quoted in the DoE statistics - trade and retail prices are bound to vary considerably according to differing mark-ups). There is quite a noticeable rise in the use of timber load-bearing panels in 1974. No explanations are given in the DoE statistics, which could be a result of the great flexibility of timber systems, being more condusive to "open" industrialisation, rather than the specialised technology involved in more "closed" systems. Timber is also condusive to centralisation of manufacture, involving relatively little investment in plant and equipment.

In America, experiments with prefabricated and temporary housing were carried out continuously from the mid nineteenth century, when the Chicago originated "Balloon" frame technique of construction accustomed local craftsman to working speedily with precut timber.

BALLOON FRAMING







Scale 1/4" = 1'-0"

Standard spacing of studs is 16" c. to c. to receive lath. Rough floor when laid diagonally gives added strength. Laid horizontally it is more economical. Diagonal sheathing is preferable to horizontal for the same reason. Change its direction at corners. If diagonal rough flooring is used, reverse direction at each floor. Hips, ridges and valleys should not be less than full depth of rafters. Ridges and hips thickness not less than 2"; valleys 3" min. Sizes are nominal. When sheathing is horizontal, exterior walls should be diagonally braced at corners for the purpose of stiffening. Unequal shrinkage exists between ext. & int. walls unless steel is used for int. girder. Best for stucco or brick veneer construction. Usually cheaper for 2 story bldgs. Less overall shrinkage.

SECTION - JOISTS AT ANGLES TO EXT. WALL h EXCAV. CELLAR
3/8" = 1'-0"

SECTION - JOISTS PARALLEL to EXT. WALL with CRAWL SPACE
3/8" = 1'-0"

Adapted from data by the National Lumber Manufacturers Association

However, very few systems achieved volume production, and none reached the figures recorded for two experimental types of houses built in Britain, the Weir and Dorlonco.

The traditional housing sector has undergone quite a revolution in the timber field, in the use of prefabricated roof trusses and flush doors - the former now occupy 90% of the market and the latter are produced by half a dozen leading firms. Undoubtedly, the potential of timber for prefabrication is great: a large number of firms in this country and the United States possess the necessary skill and equipment to fabricate structures ranging from greenhouses to curtain walls, portal frames and trusses of considerable spans. This industry is, however, more susceptible to setbacks arising from ill-informed opinion than any other in building. There is no indication that the British dislike timber - it has a sympathetic nature, gives a sense of warmth and comfort to a building and can have a great aesthetic attraction. Compared with the tradition of foreign countries, it has long been neglected as a structural material and, perhaps with its vulnerability to insect and fungal attacks unless carefully treated and used, and the inherent fire risk, public and professional opinion has been conditioned to avoid it. Also, the war-time scarcity and inflated prices of post-war years doubtless militated against it.

Going back to the United States, the percentage of factory built houses increased from 5 in 1950 (Burnham Kelly, International Congress for Housing and Town Planning, Amsterdam 1950) to 20 in 1963 ("The Builder", March 1963). There, capital invested in the timber industry is turned over seven times annually, whereas, the ratio is only 2½ to 3 in Britain. On this small turnover, the number of British firms able to use modern techniques and highly mechanised operations is surprisingly large.

The last structural material is metal, usually steel. Cast iron was used in the early days of industrialised building, but steel in its different strengths and properties has long since taken over, since it can be produced in many standard patterns and lengths making prefabricated frames and panels fairly easy to design. Steel is perhaps not generally thought of as a material used very widely in housing construction, but, although with reference again to table XIX, the frequency of its use is not much less than that of brick or timber, it seems to be declining - this is probably because steel is becoming relatively more expensive compared to timber and certainly compared to concrete, but there will always be markets for steel as a framework for larger industrialised buildings i.e. offices, social facilities complexes, warehouses, factories etc.

Apart from concrete and timber, it seems evident that the two wars did most to promote the use of steel for housing. After World War I, all prefabricated work was directed at overcoming the shortage of skilled craftsmen that dogged the country for more than a decade. The Weir House (1,500 completions in 1927) employed hot rolled steel sheets of a very heavy section, originally manufactured during the war for shipbuilding; the Dorlonco (10,200 completions) used a steel frame clad in rendered metal lathing. All the non-traditional housing designs without exception faithfully imitated the form of conventional semi-detached villas to an extent which gravely compromised the economic advantages their novel forms of construction were supposed to represent. Their success was also inhibited in some cases by efforts to employ cheap unskilled labour in their erection, which led to Union action.

By 1930, the economic conditions which had led to the construction of these houses no longer existed and as a result of the Depression more than sufficient labour was available for construction work and all experiment ceased.

In Vienna a prefabricated metal house was developed by Josef Hoffmann, which employed light steel sheet, corrugated for strength in the same manner as the contemporary Junkers airliners. This method like that advocated for Le Corbusiers "Maisons rurales" in 1927, (metal houses produced by methods similar to those of aircraft and cars) compared favourably with the heavy steel sheet construction employed on the British Weir house, but because of inadequate market research, under - capitalisation and a misunderstanding of the real strength of public resistance to insubstantial-looking forms of housing, neither project had even the modest success of the humble British equivalent. "The dream of housing produced like automobiles was nowhere realised" (Pawley, "Architecture versus Housing"). Buckminster Fuller devised a twin-drum dwelling from standard steel grain bins and, at one time, production rose to 1000 units per day. As well as being designed to serve as radar station, dormitory or field hospital, the unit was also used to house airmen in transit to the Middle East.

To combat the housing shortage during World War II, special committees from the automobile and aircraft industries were convened and design work commenced, to be given added point by a new German onslaught in the Summer of 1941, this time using flying bombs and later rockets. At once, work was expanded and thrown open to public interest to such effect that by the end of 1945 nearly 1400 methods of construction were submitted to the Ministry of Works, of which 83 were deemed sufficiently interesting for prototypes to be authorised and about 20 went into production in varying quantities. The pressed steel house which resulted from the activities of the car-based design group was exhibited in 1944 and christened the "Portal" after the then Minister of Works, Lord Portal. It was later joined by the "Arcon" asbestos-clad house, of which 46,000 were built and finally by the aircraft industry-based "Airoh" house, which achieved a production of 54,000 units; at one time, one every 12 minutes. Steel frame 2-storey houses developed at the same time included the British Iron and Steel Federation (BISF) house, of which 36,000 were later ordered and the Braithwaite house, the prototype of which was destroyed by a German flying bomb late in 1944. These latter 2 formed a bridge between the American inspired, single-storey emergency dwellings, and the traditionally-built "self contained cottages" which were, as before, to form the backbone of the post-war housing effort.

Plastics are materials that are playing an increasing role in prefabricated building, used for claddings, finishes and fittings, but it is unlikely that they will be used structurally. There are available at present whole "heart units" i.e. kitchen/bathroom units or parts thereof for installation in new or existing buildings, and prefabricated roof structures, mainly GRP made to order, but it is unlikely that its uses will diversify much further because of the relative costs, especially of the oil-based plastics.

The next chapter after this fairly brief look at materials and their methods of use, will be a weighing up of those factors militating for and against the increased use of prefabrication.

Plate I: The Braithwaite House

Chapter 2 - FOR AND AGAINST

In this chapter I am going to discuss and try to weigh up the factors that, now and in the past, militate for and against the further use of prefabrication in British housing and from the outset I must state that the majority of factors seem to be weighing against further prefabrication. It has been stated that the two major wars provided the greatest impetus for the quest for alternative materials and methods (but not housing types), but due to the apparently schizophrenic and definitely half hearted manner in which the British Government went about sponsoring and encouraging this quest, it is hardly surprising.

It may appear that the history of prefabrication between the wars is largely a succession of committee reports and design proposals rather than any positive developments in building technology, which is largely true and significant - it illustrates the timelag likely to occur between the first attempts by administrators, technologists and technicians who may have the benefit of advanced training in particular fields, to lead a traditional industry based on empirical methods and common-sense, into the new ways deemed by them to be necessary to meet an unprecedented situation.

There seem to be three quite clear-cut reasons why prefabrication as a force in the construction industry should succeed or fail:

(1) Government policies

(2) Technical advantages and/or shortcomings and failures

(3) Social attitudes

A fourth reason could be the prevailing economic climate, but as this is an indirect result of previous Government policies, it is not necessary to include it separately. Looking at these factors one by one: Government policies, while not needing to be necessarily the major factor acting in prefabrication's favour, should at least play an important part, when in fact, it has influenced the third factor, social attitudes, quite adversely by its negative efforts at encouraging prefabrication and its associated legislation and technology.

The first real attempt by the Government to coerce Local Authorities in the matter of alternative methods of building was wrapped up in the Housing (Financial Provision) Act 1924. Section 10(2) deals with acceptance by Local Authorities of approved innovations: "If at any time it is shown to the satisfaction of the Minister that a Local Authority have, without reasonable cause, refused to adopt a new material or method of construction, which, in his opinion, would reduce the cost of the house, without unduly affecting its durability, suitability or appearance, the Minister shall require the adoption of the said new material or method to be reconsidered for that purpose by the Local Authority, and in the event of their failure without reasonable cause to adopt the same, shall make such deduction from the amount of the contribution payable by him as in his opinion is reasonable, having regard to the unnecessary expenditure so incurred by the Local Authority".

The aim after World War II was to build up the normal building labour force, but to make use of novel methods to fill the inevitable gap. If this was an expedient measure, it failed to take account of long-term industrial, social and planning problems with large-scale prefabrication - it was virtually confined to a miscellany of short-term unrelated experimental houses which, even if technically feasible, had little chance of continuity in such relatively small numbers and such variety. The 1944 report of the British Industries' National Council (BINC) stated that "...(the) nucleus of standardised building should, with the consent and assistance of all concerned, take the form of state-aided National housing. With this volume secured, the benefits of the system would undoubtedly spread to building by private enterprise. This scheme should make an important contribution to the requirements of high speed and low cost. It would represent the best compromise between the benefits sought under the general name of prefabrication and the assurance of good shelter and housing for the people." The volume mentioned in this report as being necessary to secure the "benefits of the system" is something that most Local Authorities and certainly Central Government has failed to achieve - it has urged the use of certain industrialised techniques but has also protected Local Authorities economically from failure to do so. Hence construction work has become very slow through the build-up of large stocks of work contractors hold to combat fluctuation in demand. Absence of incentives which might encourage quicker construction inhibits better site organisation and represents a capital loss invested in unfinished buildings, which is a non-productive asset.

It was emphasised in the second report of the Chief Scientific Adviser's Division of the Ministry of Works (Special Report No.10 - New methods of house construction 1949) that the best results were obtained when a system was supported by an organisation conceived entirely for its own requirements: design, production and erection being integrated in one all-embracing organisation ensuring the correct phasing of factory and site processes i.e. a "closed" industrial system. The Government ever cautious, (usually to the detrement of the industry) restated the acceptable standard of durability of a house in it's first Housing Manual of 1944, as being that of a well-built brick house with plastered walls and ceilings, boarded floors and tiled or slated roof, on which the Ministry gave a loan sanction of 60 years, so after taking two steps forward, it then smartly took one step back. Both in England and Scotland, the 60-year loan period continued to form the basis of any assessment of durability on "non-traditional" houses. The Burt Committee's Report, also of 1944, contained an assessment of the durability of these houses and maintenance required compared to traditional standards, but it was couched in such vague terms as "not expected to give rise to heavier maintenance than a traditional house". Rarely was it possible to provide a more positive or quantitative estimate for any part of the house that may require replacement within the specified 60 years.

One method of procedure and type of associated construction which can certainly encourage prefabrication is the now well-known "CLASP" (Consortium of Local Authorities' Special Programmes) which is used for school-building, in which the keynote is the co-operation of a number of County Authorities and their architects, directed towards large-scale placing of building components orders over a predetermined period for an assured programme of building. A scheme has also been evolved by which a private architect can participate by using standard drawings for a range of components which the consortium can supply.

Quite a concise definition of the problem was put forward by the United Nations Economic Commission for Europe in 1959, in a paper entitled "Government policies and the cost of building". A relevant paragraph reads thus:

"The question arises whether the type of intervention practised by Governments has not tended to diminish the incentive to the industry towards technical improvement, since by it's very nature Government policy tends to take largely for granted whatever is the given level of real cost. Furthermore, demand on the industry has often been over-full, and Government intervention has in fact sometimes tended to increase costs. Part of the difficulty lies in the fact that hitherto technical progress in the building industry has been gradual; there has so far been no single technical development which has in itself offered the prospect of a radical decrease in the real cost of house building".

After all this effort, it seems that if all the time and ingenuity expended on examining novelties had been concentrated on a co-ordinated rehabilitation of the house-building industry together with an extension of standardisation and a thorough investigation and overhauling of site operations, it is at least arguable that houses as sound functionally in every respect as some of the novel types could have been produced as quickly and more economically than most of the experimental housing.

The next major factor likely to influence the popularity of prefabrication is the technical merit of non-traditional buildings. It is an established fact that prefabricated buildings can be cheaper and more speedily erected than traditional buildings, due to the production-line techniques involved (although not necessarily so), but if they feel insubstantial and start deteriorating within ten years or so, the public's opinion of them is bound to be unfavourable.

It is also possible that the "general public's" idea of a prefabricated building is essentially a small building, remembering post-war "prefabs", when, in fact, such buildings can be more or less any size.

In support of traditional building techniques, it could be argued that the brick is the most convenient standard building component ever produced because:

(1) It is a suitable size to transport and handle.

(2) It can be fitted into any corner of a building.

(3) It almost always produces an aesthetically pleasing effect,

but it is also true that:

(i) Its nominal and actual sizes may differ considerably.

(ii) These sizes are not universal, despite the Housing Regulation of Size of Bricks Act, 1924.

(iii) It does not readily lend itself to prefabrication.

Although (iii) in part 2 is generally true, bricks are used in non-structural cladding panels, but it's use is purely decorative - a dishonest use of a structural material for the sake of appeasing accepted ideas.

Unfortunately, a lot of non-traditional houses erected even quite recently have suffered from deterioration, but this has not necessarily been the fault of the material or system involved - it has usually stemmed either from a complete lack of understanding of the characteristics of the materials involved, or insufficient information about design methods and handling peculiarities through lack of time or finance for research and development. The scattering of identical houses of non-traditional design over a site regardless of local drifts resulted in

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Ministry of Housing and Local
Government
(Department of the Environment)
2 Marsham Street
London SW1

your ref

our ref

date 6 April 1976

Dear Sirs

I am a third year BA Hons Degree student at the Faculty of Art and Design, Bristol Polytechnic, and I am writing my thesis on 'Prefabrication in 20th Century Housing'. In connection with this, I wonder if you could tell me -

1 How many Local Housing Authorities there are in the British Isles since the re-arrangement of County Boundaries; and

2 How many of these Authorities use any proprietary building systems or prefabricated components in their public sector housing.

I have checked with The City of Bristol Planning Department and they say 'This Corporation does not normally use any prefabricated system of building although one pilot scheme is currently being carried out to investigate the potentialities of timber in the housing field'. Is this fairly common under present economic circumstances?

Yours faithfully

Jon Risdon

Jon Risdon
3rd year student
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FB

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Your reference

Our reference

Date
14 April 1976

Dear Mr Risdon

1. There are 367 housing authorities in England, 37 in Wales and 56 in Scotland. In Northern Ireland there are 26 local authority districts but housing is controlled by the Northern Ireland Housing Executive.

2. As far as industrialised housing is concerned 140 local authorities and 11 new towns in England and Wales are currently using industrialised methods in housebuilding. In Scotland 17.5% of local authority and new town dwellings approved in 1974 and 19.4% in Northern Ireland in 1975 were industrialised. The Scottish Development Department Edinburgh and the Department of Housing, Local Government and Planning Belfast may be able to let you know the number of authorities involved.

3. The term industrialised covers a number of different constructional techniques and I enclose a note of the definition used by the Department of statistics on this subject. A list of the various systems currently in use, together with the number of dwellings being built, is given in supplementary table XX of Housing and Construction Statistics No 13 which you may be able to obtain from HMSO, Southey House, Wine Street, Bristol BS1 2BQ price £1·40 net.

4. I cannot confirm that the information you obtained from the City's Planning Department is typical of local authority housing in the country but of 24,500 dwellings completed in England and Wales in 1974 for local authorities and new towns 61% had concrete as the main structural material, 24% timber and the remainder split more or less equally between steel and brick.

Yours sincerely

E C West

E C WEST
Statistics Housing

many houses of a given type keeping out the weather while a few others of the same type, because of this arbitrary siting, failed to do so, and it is worth citing a couple of examples.

Rain penetration was suffered by many of the Scandinavian timber-framed houses imported into this country after the second World War and erected on the West coast of Scotland. Apparently, they were far from cheap to begin with, and since their erection they have required extensive repair. This problem was also experienced by some "Waller" houses, 100 of which were still in existence in Poole, Dorset in 1968. The houses had cavity walls, using precast concrete outer-wall slabs of storey-height and precast clinker concrete (to reduce the weight) inner-wall slabs attached to in-situ poured columns and combined ring beam and first floor. Due to the fact that the first floor slab projected beyond the outer wall leaf to provide a division between the storey-height slabs, it interrupted the wall cavity, and considerable trouble was experienced from rain penetrating through to the ceilings and internal wall surfaces.

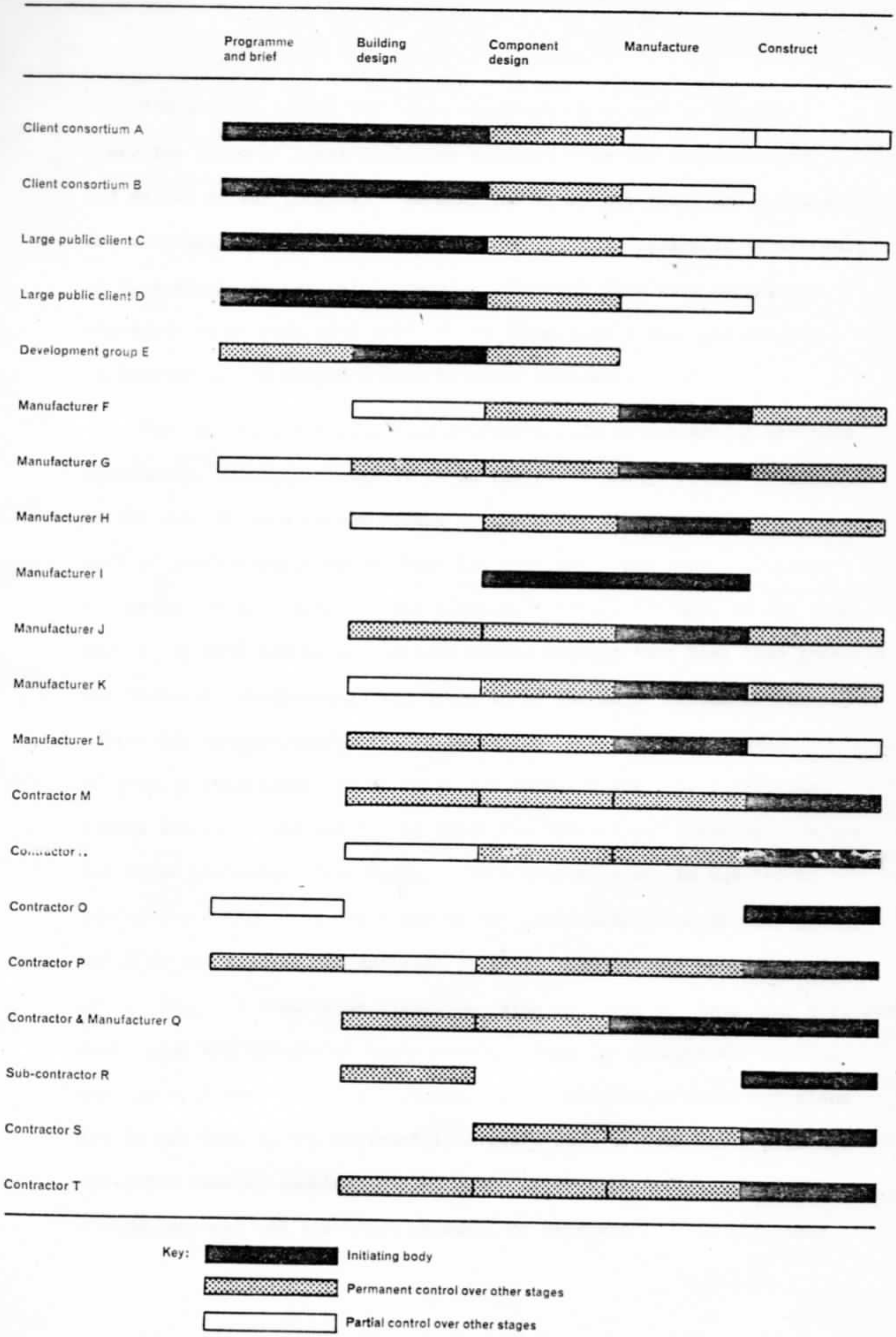
Another method of building concrete houses was using permanent shuttering of asbestos cement which unfortunately cracked in places, allowing damp to penetrate. Although they were erected quickly and the initial cost was quoted at 15% less than brick houses of comparable size and location, they have cost considerably more to maintain. Obviously, there are many types of non-traditional housing which have proved highly successful, but it is usually only the unsuccessful examples that are quoted.

As far as part-prefabricated houses are concerned, there is a problem of co-ordination, dimensional or otherwise, between all manufactured components and other parts of buildings containing traditional work, presenting difficulties which will take time to resolve. Furthermore, the profusion of products and the wideness of the market has, for architects primarily, aggravated rather than simplified the problem of the built environment in the industrial age.

One of the main reasons why prefabricated systems are not used more often is economic rather than technical failings - apart from "open" systems in which components can be bought from standard stock ranges, the public sector housing programmes which would probably employ "closed" systems are rarely large enough to justify factory production and the requisite investment. According to Dr. Triebel, contemporary head of the West German equivalent of the Building Research Institute, writing in "Der Querschnitt-bau", May 1959, ".....the threshold of economic operation appears to be around 300 dwellings in one series. It is an obvious condition of economic success that no alterations shall be made (to a run of components) once prefabrication has begun". This figure is likely to vary between contractors and manufacturers, but it is a very useful guide. Although it might be difficult for Local Authorities to organise housing programmes of comparable size in existing conurbations (not necessarily all on one site) this has been achieved in some of the New Towns, which the DoE include in their statistical assessments.

The last word in this section should definitely go to the contemporary Director of "Ratiobouw" (no definition available) at the Hague in Holland:

Diagram 7: Organisations created to use various industrialised methods



"An obvious reason why house construction cannot be organised along the lines of industrial mass production is the intricateness and volume of the product. So many different materials and components are necessary for a house that it is out of the question to manufacture it by a simple mechanical process". Although this very definitive statement is at odds with some of the ideas that I will put forward in Chapter 4, I'm afraid I have to agree with him.

The last factor influencing Prefabrication is our social attitude towards it, which, although it is an important enough factor to stand on its own, it is a direct result of the first two factors - the sort of prefabricated houses that the Government has deemed suitable for us to own and rent, and the technical virtues (or not, as the case may be) of both public and private sector housing that have been produced. The technical shortcomings are bound to be the major social factor militating against prefabricated buildings, but this is a result of housing programmes not being so co-ordinated that the inevitable faults can be ironed out in the first few "prototype" buildings, before the major production runs begin. This situation can be equated to production design (the motor car is the usual comparison at this point, but I do not see the car as being valid in this context because it is, of necessity, a compromise situation using outdated and less than efficient mechanical and industrial techniques). Take for example the washing machine - if they continually leaked water, the Public would not stand for it and that is why aspirant innovators such as John Bloom with his cut-price washing machines failed - the product is, relatively speaking, a necessary one and therefore it must, of necessity, be as efficient as possible, but this logic has not been applied to Prefabrication: perhaps it has just not been humanly possible.

In Chapter 3, I will look at three case-histories, two well known and one not, to try and point out where each has succeeded or failed.

Chapter 3: CASE HISTORIES

(1) Quarry Hill Flats, Leeds

The system by which these flats were built is very similar to one which was developed in France in the late 'thirties by Eugène Mopin, a civil engineer, for building blocks of flats in which an unusually light structural framework of hot-rolled steel sections was partially encased in site-poured and vibrated concrete which, under French building regulations, could be assumed to share a portion of the total load. This framework was then clad with vertical T-shaped precast concrete units which were ultimately linked with the steel frame and the in-situ concrete that partially encased it. It was claimed that savings in cost by this system had enabled certain other features to be introduced into these flats, which, but for the method of construction, could not have been afforded. One of these features was the "Garchey" system of refuse disposal.

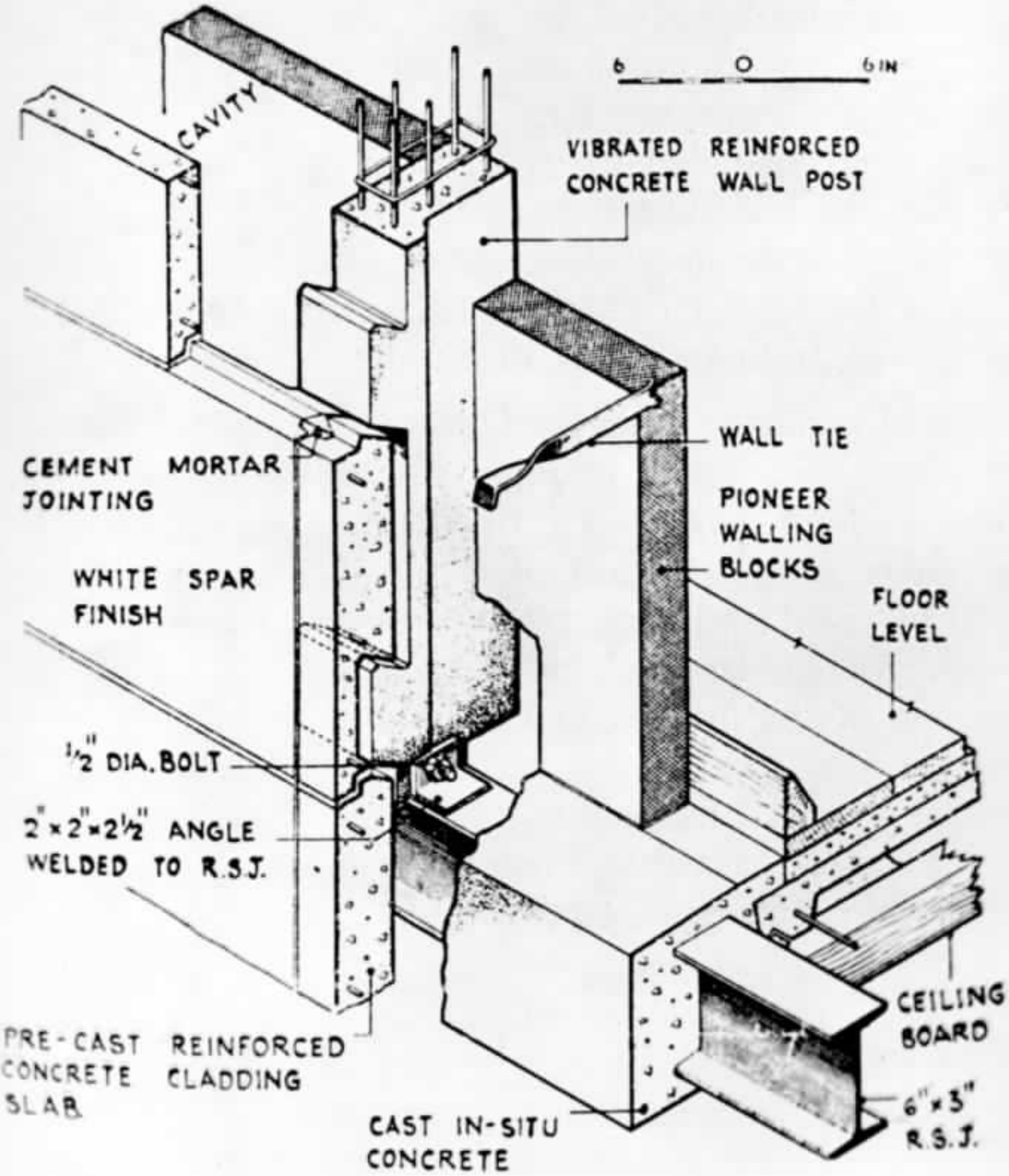
It was only after a report had been compiled by the Building Research Station on the French system that the go-ahead was given for its use in this country. Apart from the structural assumptions made for this type of frame and certain reservations in respect of fire resistance, the report was generally favourable as regards the possibility of satisfying other functional requirements for this country.

At Leeds, the Quarry Hill area of 28 acres comprised 2790 dwellings, 53 public houses, an old brewery and two old burial grounds as well as other obstructions. This area was acquired by the City Council for redevelopment and the now well-known Quarry Hill flats were built there (see photograph). The then Chairman of the Leeds Housing Committee,

Plate 2: Quarry Hill Flats, Leeds

Councillor the Rev. Charles Jenkinson, in conjunction with the City Architect, the late Mr. R.A.H. Livett, had studied Mopin's and other Continental structures and decided that Mopin should be consulted about their scheme for 938 flats on that site. After struggles with various authorities over planning, byelaws and structural matters, the persistence of the Vicar and his tireless architect won the day; work commenced in 1937 and was completed in 1940. The scheme embodied the "Garchey" refuse disposal system, installed for the first time in Britain. As in France, it was claimed that the economies made by using the "Mopin" system enabled the "Garchey" system to be used. The general contractors for the whole scheme were Tarran Industries of Hull.

All the vibrated concrete units for Quarry Hill were cast in a site-factory, and the light steel two-storey to eight-storey frames were assembled and welded on the ground and raised by derricks onto their concrete pier foundations. There frames consisted of double-channel stanchions, separated and connected by front and back plates welded on at intervals and, at floor and roof levels, of cross-beams which rest on and are welded to them. This was not only one of the first welded structural frame jobs of its size in the country, it was also one of the earliest to make use of vibrating-tables whereby a semi-dry mix of concrete could be rapidly consolidated, and the moulds stripped for re-use within a few hours. The frames were generally set 12 ft apart and were bolt-connected round the perimeter of the building by rolled-steel joists, to which were bolted reinforced concrete posts, 2 to each bay forming 3 equal divisions, and against which concrete facing slabs were fixed by means of concrete projections at the ends and rear, which engaged corresponding projections on the posts (see photograph).



Courtesy 'Building Equipment News'

Typical external wall construction

FIG. 2.13. Quarry Hill Flats, Leeds

The rsj's were afterwards encased in concrete and concrete was also poured in between the stanchion channels and then vibrated.

One of the advantages claimed by Mopin for his system was that of adaptability to various forms of architectural treatment and cladding of the structure. The vertical cladding slabs previously used by him, which had been held by bolts through the supporting members, were changed at Leeds in the early stages, in favour of horizontal slabs, fixed as described above, except for the slabs facing the staircases, which remained vertical, and the corner slabs, which were fixed to the corner stanchions. Also, the precast slab cladding was extended down below finished ground level where, in the French work, traditional building had been used. In view of Mopin's interest in this application of his system, it would be reasonable to assume that he had approved these changes, at least in principle, if not in detail. The external facing slabs of which some 76000 were used, were in general about 4'6" long 1'6" high and 2" thick and were fixed in bands of 3, 4'6" high. Alternate bands including window openings, were recessed. These bands were faced with an exposed aggregate of brown washed gravel, while the outstanding bands were faced with Derbyshire spar. It was hoped, vainly as it turned out, that the rain would keep the exposed aggregates clean; They became encrusted with grime, but the recessed bands showed the dirt less than the others.

In 1960, it became clear that water was penetrating to the steel reinforcement of the slabs in many areas, not only in the parapets. There was a risk that a slab or portion of a slab would fall, and cause an injury below. A consulting engineer was called in to report on the condition of the structure and cladding, and to make recommendations. Regarding the structure, it was found that the concrete infilling in those stanchions that were examined was poorly compacted and incapable of taking the load intended. Regarding the slabs, the situation was considered sufficiently serious to justify their total replacement by a rendering to be applied in-situ. Even this it was considered, would only extend the useful life of the external walls for a further ten years or so, at a cost estimated in 1961 of some £343,000 (The Times, 19th July 1961).

The stanchions inside the building are encased with the blockwork of anhydrite plaster blocks of which all the inner linings of the external walls, the party walls and the partition walls were built. These slabs or blocks are generally 2' long, 12" wide and 2½" thick and weigh 65lb/ft^3. They are finished internally by a skim-coat of plaster. In the external walls they were tied wherever possible to the back of the external facing by wall-ties. The party walls are built of 2 leaves of such blocks spaced apart, but of a denser plaster than the remainder, weighing 75lb/ft^3.

The floors and flat roof are supported on secondary steel joists spaced about 4'9" apart and bolted to the main cross-beams. They carry precast concrete structural floor "trays" 1¼" thick and 1'8" wide. With reinforced ribs and edges thickened to 2". The reinforcement projected sufficiently beyond the ends of the trays to enable it to be wrapped over the top flanges of the filler joists. The gaps left between the trays were then filled with concrete. To support the trays prior to concreting, they were laid on concrete "stools" that stood on the bottom flanges of the filler joists and to which were afterwards fitted timber ceiling joists 3X1½", carrying fibreboard ceilings ⅝" thick. The ceilings were not plastered but the joints were scrimmed before distempering. Timber flooring was nailed to battens set in a layer of clinker concrete laid over the structural trays. The asphalt rooves were said to have had granite chips rolled into them; when seen in 1959, the surfaces were black. Chimney stacks were built of brickwork, separately from each floor level. All staircases were assembled in-situ from separately precast stringers and tread-and-riser units.

Quarry Hill was a gesture of faith, for apart from being probably the largest comprehensive housing project of its time in Europe, it embodied several innovations and for these reasons has attracted architectural students and other visitors from all over the world. It may also serve as a reminder that where a system of construction, designed and developed elsewhere in other circumstances, is altered and adapted to suit different requirements, very careful thought must be given to the possible results, in the new environment, of such changes. Quarry Hill was also a response to an opportunity and, owing to the circumstances of the period, was also a fortuity, as has so often been the case with "successful" ventures in unconventional building. The opportunity was provided first by the necessary housing legislation for compulsory purchase and clearance; secondly by the unattractive character of the local bricks, and the possibility of a shortage, for so large a scheme of both bricks and bricklayers. The fortuity was the unusual collaboration of 5 individuals of outstanding personality and perseverance: the Rev. Jenkinson, R.A.H. Livett, Eugene Mopin, Robert Tarran, the builder, and Louis Antoine Garchey. The "Mopin" system as such has never, so far as is known, been tried again in Britain.

By the time the Second World War was over, Mopin himself was an old man (he died in 1955 aged 81) and it is unlikely that he would have wanted to compete in the field of two-storey house-building. The nearest approach that was made to it was very much later, in 1950 at Newcastle upon Tyne, where several blocks of flats of 5 and 8 storeys were built as a slum clearance scheme.

(2) The Aluminium Bungalow

The aluminium bungalow (see photograph) was by far the most highly prefabricated house in the war-time emergency housing programme. Production of complete bungalows was concentrated in 5 large factories, well distributed over the country, and assembly-line methods were used to produce each house in 4 fully finished units which required mechanical handling and transport on special low-built trailers. There was therefore no need for centres of distribution for separate components.

Early in 1944, the possibilities of and problems involved in making use of the production capacity released by the inevitable end-of-war decline in fighter aircraft production, to stimulate and make an important contribution to the post-war housing programme, was exercising the minds of ministers and industrialists. If a temporary house of which the principle parts were of aluminium alloy could be successfully prefabricated in these aircraft factories, then much of the labour employed there during the war could be retained, until gradually re-absorbed, and stocks of alloy, including scrap from aircraft, could be used to great advantage to help solve another National problem. The proposition was attractive. At the time of the passing of the first Housing (Temporary Accommodation) Act 1944, the intention

Plate 3: The Aluminium Bungalow

was to proceed with 50,000 steel houses, as well as other types, for the equipment of which some 200,000 prefabricated steel kitchen-bathroom units and sets of steel cupboards had been ordered. When it became clear that steel houses could not be produced in sufficient quantity before the middle of 1946, it was decided to concentrate instead on a temporary aluminium house, the production of which was considered feasible at an earlier date.

The development of the design for the Aluminium Bungalow was entrusted to a joint organisation of the aircraft industries and the Ministry of Aircraft Production. This was known as the Aircraft Industries Research Organisation on Housing (A.I.R.O.H.). The Government departments concerned insisted that the house be designed specifically for the temporary housing programme, that is for a life of ten years. The designation "temporary" was not very palatable for the designers, but the condition was nevertheless accepted.

In the Aluminium Bungalow the entire plumbing system was contained in one of the four units, so that no plumbing joints had to be made on the site. The transport of the units imposed limitations of weight and size, but the lightness of the metal and of the air-entrained cement grout used to fill the panels of the external walls enabled the heaviest unit of 2 tons 15½cwt (that containing the kitchen and bathroom assembly) to be kept within the maximum transportable load. The 7'6" limit of width on many roads had perforce to be accepted as a fundamental design consideration.

With the exception of the nailing down of the floor-boards, which was done by hand, the entire production was a mechanised process.

The wall frames, like shallow trays, were first sprayed on the inside with hot bitumen, then immediately passed under a battery of cement pourers to be filled with air-entrained grout, which provided an insulating layer. The partly made wall panels were then passed through low-pressure steam drying ovens which enabled the grout to reach full strength in 48 hours, after which a further layer of bitumen was sprayed over the exposed cement face and to which, while still hot, a $\frac{1}{4}$" plasterboard inner lining was pressed and secured by nails to wood fillets fixed to the frame. The layers of bitumen were intended to provide a water and vapour barrier and in addition to take up any relative movement that might be caused by different rates of thermal expansion. They did not however provide the continuous vapour barrier expected, because the first layer of bitumen became unevenly displaced over the aluminium sheeting when the grout was poured; moreover, the formation of small bubbles in the second layer also prevented continuity.

The finished wall was $2\frac{1}{4}$" thick and gave a thermal insulation equal to a 11" brick cavity wall with a plaster lining. The underside of the corrugated roof sheeting was likewise sprayed with bitumen, to which 1/16" millboard was fixed. The ceilings were of fibreboard on timber frames fixed to the aluminium trusses, and included additional insulation of glass fibre (the first mentioned use) under which was a layer of building paper, intended to act as a vapour barrier.

The final assembly of the components was done on the moving belt system (see photograph) during which the final paint spraying was carried out. Previously, the aluminium parts requiring special paint treatment, such as windows, had been passed through the appropriate

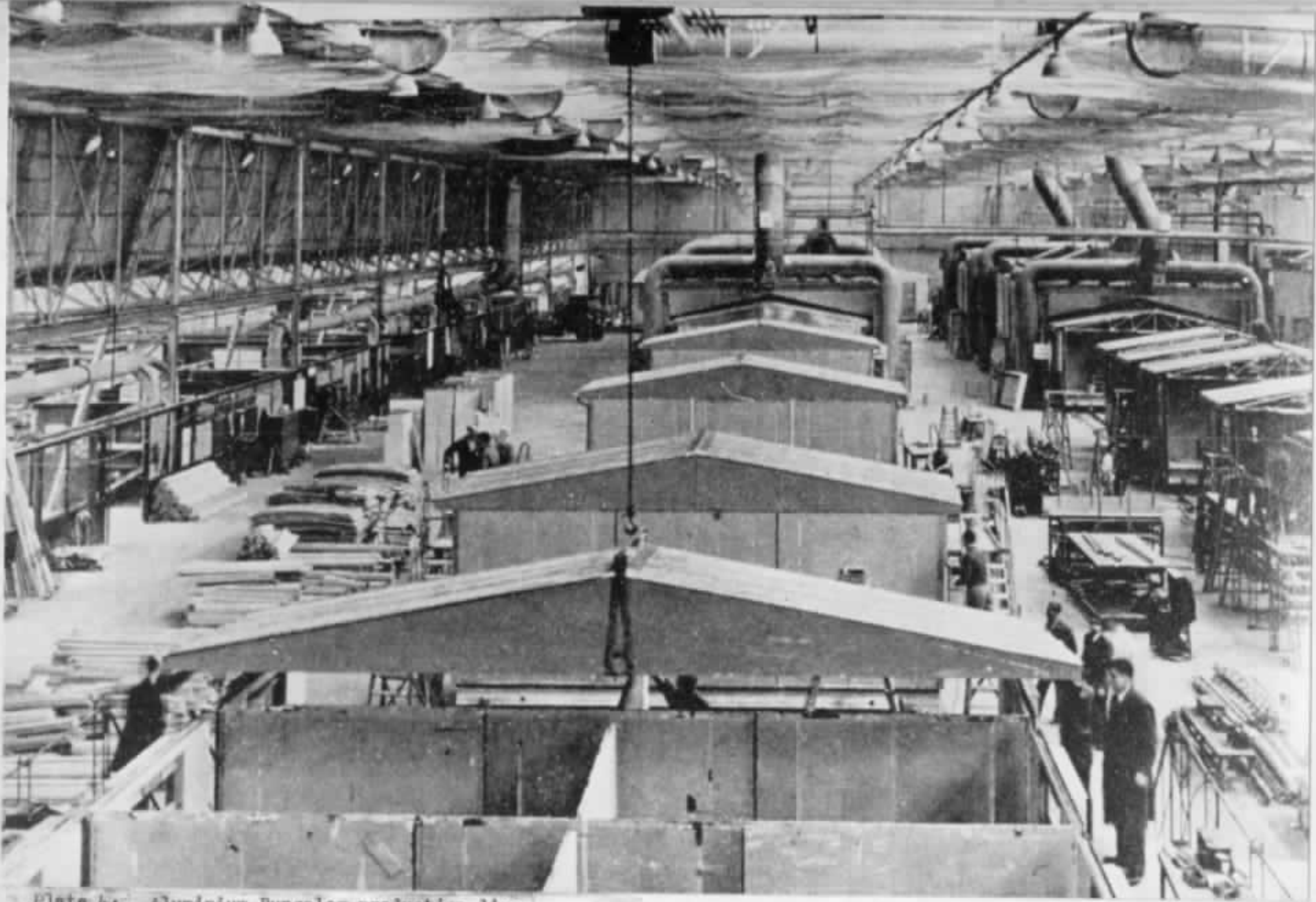


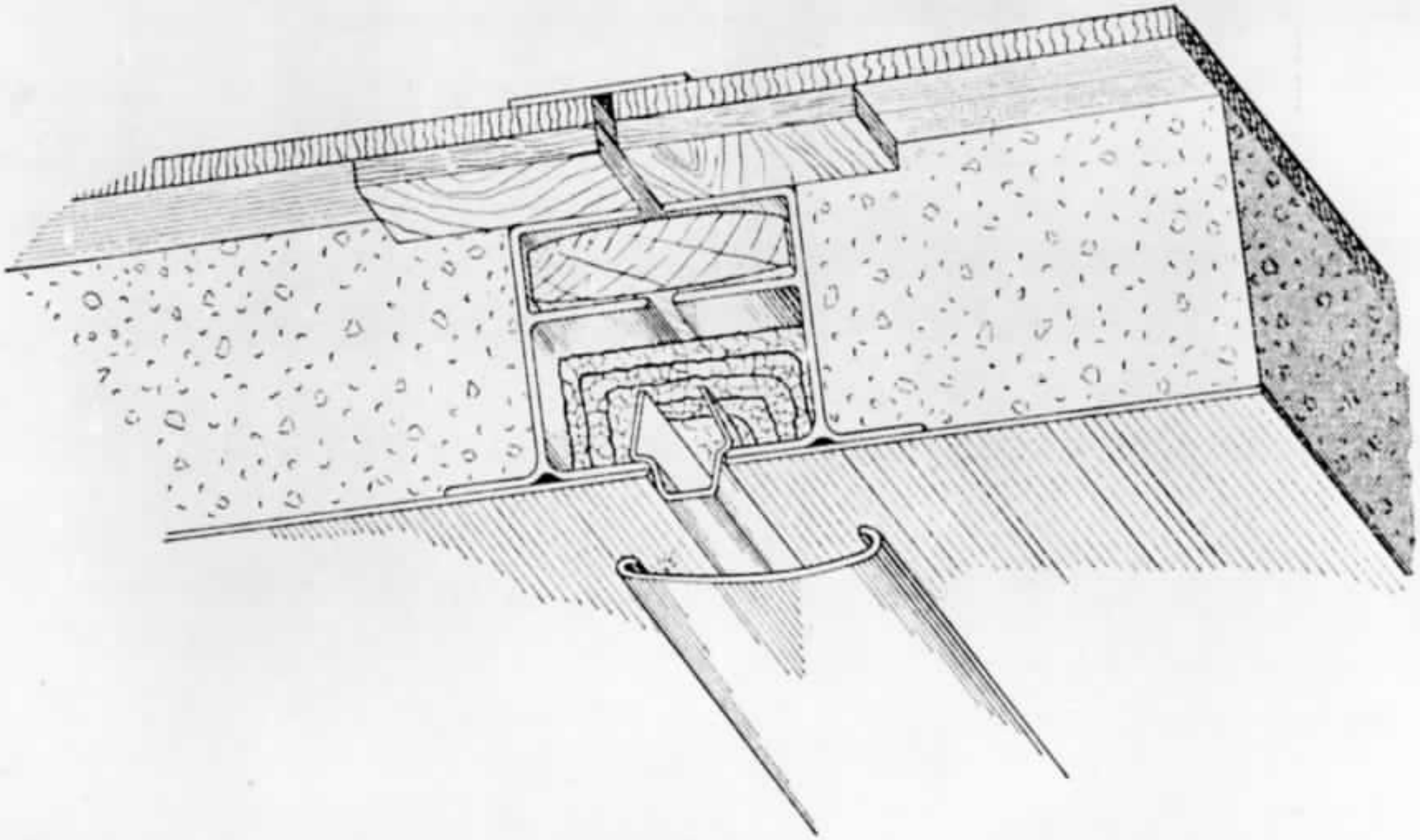
Plate 4: Aluminium Bungalow production line

process of pickling, dipping and drying. Each unit of the house emerged fully wired for electricity, wired and painted.

The houses were contracted for and produced under the direction of the Ministry of Aircraft Production (later Ministry of Supply). The preparation of the sites and concrete slabs and dwarf walls on which they were erected was the concern of the Ministry of Works, whose responsibility ended when the houses were finally accepted by the Local Authority in whose area they were built.

When the 4 low trailers, each carrying a unit of the house, arrived at the nearest spot convenient to the erection site, they were backed up between collapsible gantries which lifted the units clear and lowered them onto trolleys fitted with screw-jacks and rollers, enabling the units to be pushed along parallel sets of rails to their appropriate place on the foundation slab. For erection on sloping sites, however, a 5-ton travelling crane had to be used. As soon as one unit was ready to be joined to the next, a wooden batten was placed in the vertical channel in the edge of the wall panel, ready to engage in a similar channel in the abutting wall panel (see photograph). This batten thus acted rather like the tongue in matchboarding. The cavity in front of the battens was then packed with glass-fibre which was finally enclosed with spring cover-clips of aluminium: similar strips protected the roof-joints.

At the eaves and base of the wall, the units were locked by U-shaped interlocking connector blocks of aluminium through which a pin was driven horizontally. The main services were all carried in the kitchen-bathroom unit and work on joining them up could begin before the house



Courtesy Aluminium Federation

FIG. 3.4. The *Aluminium Bungalow*—site joint between wall panels

was completely erected. Extension of electrical wiring to the remaining units was made by plugs and sockets. Erection time would vary a great deal according to the site; 20 man hours has been commonly quoted.

The floor area of the Aluminium Bungalow was 629ft^2. In the October, 1945 White Paper, the cost was estimated at £1365; by 1947 the cost was given as £1610 and this did not include a proportion of the cost of tooling the factories for this programme, a cost which could not possibly be amortised over 10 years of use. It was then by far the most expensive of all the temporary houses, costing about £400 more than the "Arcon" house of similar size and equipment, despite the fact that some 20,000 more aluminium than Arcon were produced. There is no doubt that this revelation of cost did much to shake belief in total prefabrication, particularly as the houses were officially classified as temporary dwellings.

The Aluminium Bungalows were indeed designed as temporary dwellings; seen as such, structural deterioration did not render any house uninhabitable, even after 12 years, but from 1953 onwards, incedences of corrosion of aluminium structural members were reported in increasing numbers, notably corrosion of those members at the base of wall panels where moisture was held for long periods. The prevention of further corrosion and traditional methods of repair were rendered extremely difficult owing to the factory method of construction, a factor to be considered in any design of prefabricated buildings.

In common with other types of temporary houses that included excellent fittings, many of these, such as cookers, refrigerators

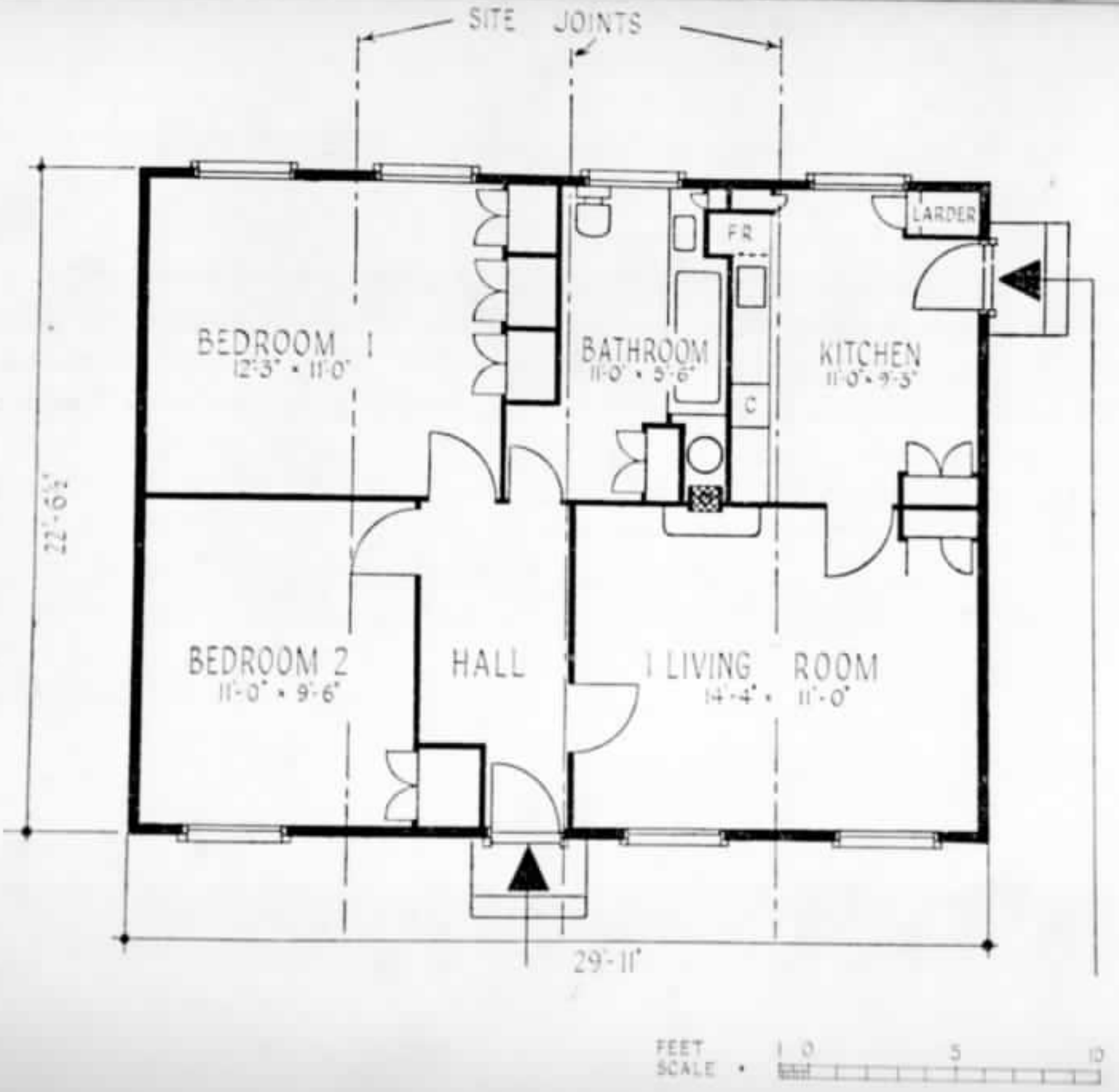


FIG. 3.3. The plan of the *Aluminium Bungalow*, showing the four sections

sinks, drainers, cisterns and sheet steel casings began to show steady deterioration after about 15 years, requests for replacements becoming more and more frequent. Nevertheless, tenants generally expressed complete satisfaction with the living conditions and were loath to leave these houses for more permanent quarters. A more serious drawback from their point of view than incidences of corrosion of the aluminium was the occurrence of condensation. In a large number of instances this fault was found to be the result of cooking and washing with inadequate ventilation of the roof space. It had been hoped that the millboard under the roof sheeting, apart from providing some additional thermal insulation, would direct condensation occurring under the metal roof sheeting to the eaves, and allow it to drain away outside. However, owing to the large amount of vapour produced in some homes, and the lack of an effective vapour barrier in the ceiling, the millboard in some houses became saturated and detached, and condensation collected in the ceiling panels, which eventually leaked. The B.R.S. suggested providing a double layer of aluminium roof sheeting with a cork sandwich. The double layer was indeed provided in some later bungalows of similar type embodying a few alterations of detail, following which they were categorised as "permanent" houses, but the cork sandwich was omitted and fibreboard was used under the sheeting instead. Even so, the troubles from condensation appear to have been less frequent in these latter "permanent" B2 houses than in the original version (B1) intended for a 10-year life.

In spite of these occurrences, and its probable complete disappearance from the scene in another 10 years or so (see letter from City of Bristol

Assistant City Planning Officer
Architectural Services
Cabot House
Deanery Road
Bristol BS1 5TZ

18 March 1976

Dear Sir

Thank you for your letter of 27 Janurary 1976. I have delved a bit further into the industrialised and prefabricated building field and there are a few more questions that I would be very grateful to you for answering concerning Bristol;

1 How many tenants still live in post war temporary or permanent non-traditional houses?

2 Is there a rehousing programme in operation for these tenants, and if so, when is the expected completion date?

3 What sort of accommodation would you rehouse these tenants in, and would it be in the same area if possible?

4 What percentage of high rise to low rise/high density public sector housing do you aim for (dependent upon Goverment changes etc)?

5 What is the name of the pilot scheme currently in operation that you mentioned, and has there been the close liason between client, architect, manufacturer and contractor that is employed in the CLASP system for school building?

Yours faithfully

Jon Risdon

Jon Risdon
Third year student
School of Construction

City of Bristol

Housing Department

Cyril F Fortune DipPolEcon(Oxon), FIHM, MILGA
Director of Housing

The Council House
College Green Bristol BS1 5TW

Telephone (0272) 26031

When calling or telephoning about this letter please ask for Mr. Payne *Ext.* 349

Jon Risdon, Esq.,
School of Construction,
Bristol Polytechnic,
Clanage Road,
Bower Ashton,
BRISTOL.
BS3 2JU

Your ref

Our ref JSP/JMB

Date 7th April, 1976

Dear Sir,

The City Planning Officer has passed me your letter of the 18th March enquiring about industrialised and prefabricated building in the field of housing. The answers to your questions are as follows:-

1. At the end of 1975 there were 1684 temporary prefabricated units still occupied. At the end of 1972 there were approximately 17,000 non-traditional houses occupied.

2. There is a rehousing programme for temporary prefabricated unit tenants where these units have a short life and are deteriorating. However, a number of these units have a much longer life and are not programmed for removal at the present time.

3. As far as possible tenants from prefabs are rehoused in the type of house and area they choose. This is often the same area although some tenants use this as an opportunity to move to another area of the City.

4. Because of the problems arising in high rise housing in the past no high rise developments are currently being planned other than one 6-storey block in St. Pauls. Developments are therefore generally low rise of various densities depending upon the situation.

5. The pilot scheme currently in operation at Brentry Farm, Twenty Acres Road, is of Platform Timber Frame Construction by K.E. Millard & Co. Ltd. As with most industrialised building techniques there is close co-operation between client, architect, manufacturer and contractor.

I hope the aforegoing is of use to you.

Yours faithfully,

for Director of Housing.

Housing Department), the Aluminium Bungalow must be recorded as a great historical achievement in prefabrication. It made a timely, though costly, contribution to the easing of the serious housing shortage at the end of the war, and at the same time helped the large aircraft industry built up during the war to re-adjust itself to peace-time conditions.

(3) Winterbourne and District Community Association Centre.

Although this last project is not concerned with housing, it uses a structural timber frame system which could easily be adapted to use for housing, and, apart from the actual size of the project, it is probably indicative of the general progress of a timber-frame system.

The building is intended to be used by Winterbourne and District Community Association, comprised of residents of this small semi-rural area on the outskirts of Bristol. Before deciding to build this centre, the Association met in a local school, which no doubt was somewhat inconvenient and the need was felt for a purpose-built structure which would house them and their required functions (eg. general meetings, leisure activities etc). A committee was formed to administrate the matter, and with the collaboration of the architect, a Mr.J.A. Powell, a member of the group who volunteered his services, and who has previous experience of the use of prefabricated elements, a site was found. The decision was made by the group to use a prefabricated system, essentially because it would be cheaper than a traditional building (although originally the possibility of purchasing an existing building had been looked into, and discounted for the same reason) and it would also provide the internal flexibility necessary for a building of this type.

Design Notes

Controlling Dimensions:
The structural planning grid is 600mm x 600mm. All glazed window and door panels are 1800mm wide, but they can be placed at any position in the external walls on the 600mm structural grid. Blank wall areas of any length in 600mm multiples can be accommodated using the 600, 1200 and 1800mm wide blank panels. A blank panel 1200mm wide with centrally placed single door is also provided.

Plans and elevations can be developed without regard to the roof or first floor beam positions, as roof beams can be spaced at 2400mm and 1800mm, and first floor beams at 1800mm and 1200mm, irrespective of wall panel junctions, windows or doors.

The internal non-structural partition planning grid is 300mm x 300mm and virtually any situation on this grid can be accommodated by the range of standard panels, 300, 600 and 1200mm wide blank panels, and 1200mm wide panel to accept a single door set in any position within the 1200mm width, and 1800mm wide panel to accept double door set.

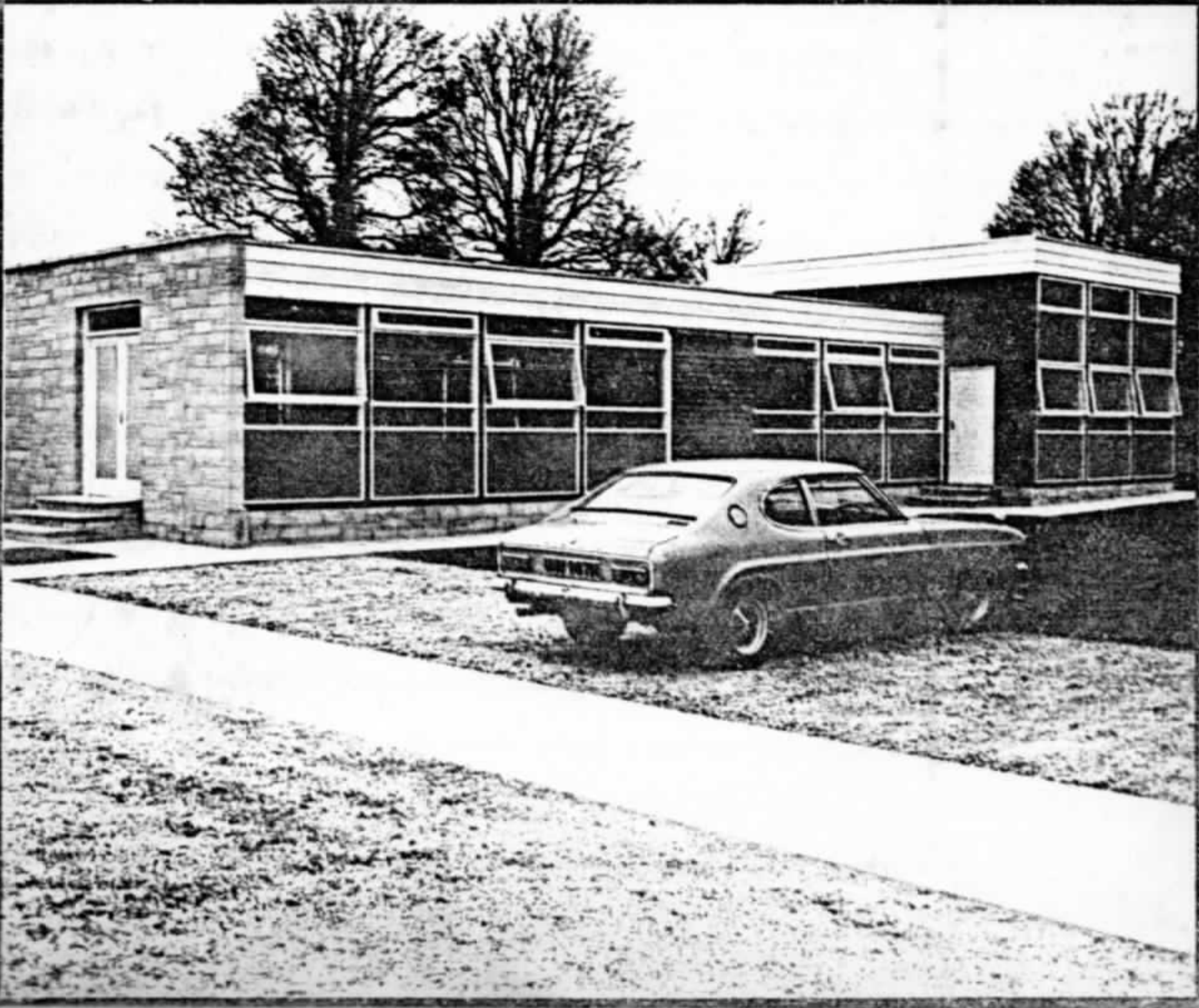
Structural partitions, for change of roof levels, multiple spans, etc., must be positioned on the 600 x 600mm structural grid, and can accept roof or first floor beams at any 600mm position. Openings in structural partitions and multiple spans can also be provided by the standard range of trimmer beams and posts, up to a span of 4800mm, and these beams will accept roof or first floor beams at 600mm positions.

The roof and first floor zones are 600mm deep, and lattice steel beams are contained within these depths, with no projection of beams below ceiling level. Normal services can be located in these zones.

Solid wall areas can be factory clad with complete skin of 5mm oil tempered Swedish masonite or 6mm flat Asbestos (for non-combustible cladding requirement), with 6mm x 120mm oil tempered masonite profiled face boards fixed at 80mm spacings, treated with two coats of textured Vinyl in which case a 600mm wide fascia of prefinished Canadian Colorlok is provided at roof and first floor zones.

Alternatively all, or any part of the solid wall-areas can be clad with site fixed brick, stone, tile cladding, etc., in which case the standard fascia can be retained at roof level or the cladding can if preferred be carried through from ground to roof line.

The panel junctions in solid wall areas are not expressed in either the factory fixed or site fixed claddings, so that



Design Notes (cont.)

the continuity of the blank wall area is maintained for any length.

The elevations are not therefore restricted to the usual repetitive modular appearance, and the planning flexibility allows the most exacting planning requirements to be faithfully interpreted.

Room Heights:
Room heights to underside of ceiling are: –

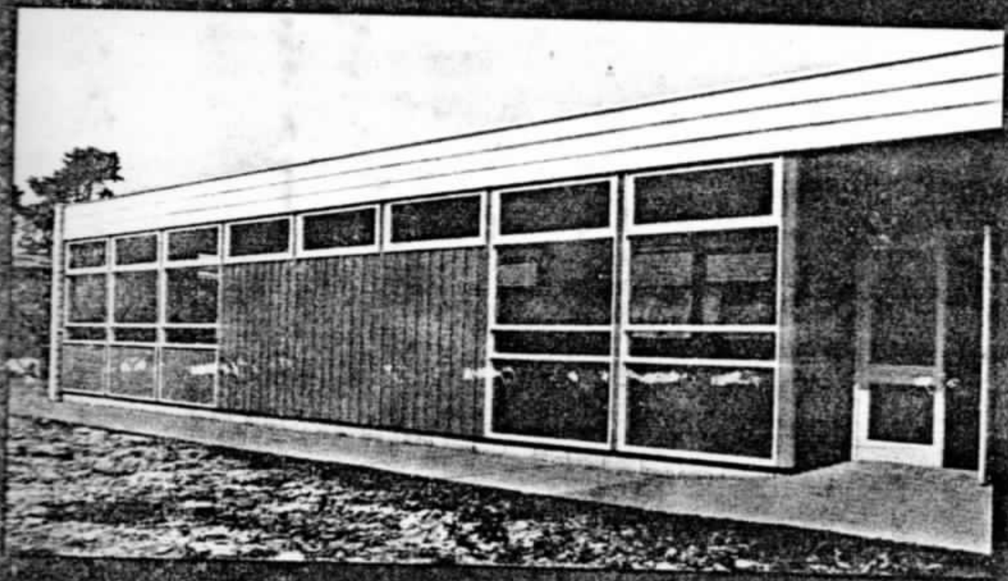
Single Storey:	2400 – 2700 – 3000 – 3600 – 4200 – 4800 and 5400mm.
Two Storey:	2400 – 2700 and 3000mm on either or both floors.

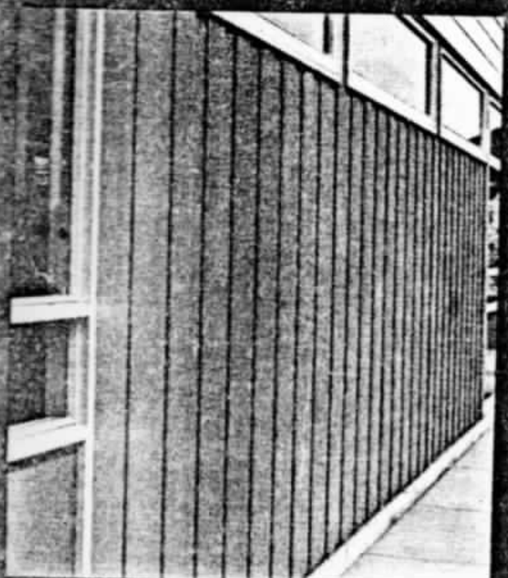
Beam Spans:
Steel lattice beams are available in the following clear span lengths: –
Roof: 3000mm to 13200mm in 600mm increments.
First Floor: 2400mm to 8400mm in 600mm increments.
10° Pitched Roof: 7200mm to 13200mm in 600mm increments.

Changes in Levels:
Changes in roof and floor levels can be accommodated in 300mm increments, and a full range of glazed and blank clerestory panels are available in the same widths as wall panels.

Insulation:
Double cavity, three skin, construction provides insulation values: –
Roof: 1.132 Wm² °C.
Walls: 1.195 Wm² °C.
These insulation values will more than adequately meet any normal requirements, but for special situations, the values can be increased by the addition of fibreglass over the ceilings and/or in the walls.

Regulations:
The Pratten Free Plan system meets the requirements of the Building Regulations, and conforms structurally with British Standard Code of Practice 112: 1967 and C.P.3 Chapter 5, Parts 1 & 2, 1970.
Standard Loadings are: –
Floor – superimposed load: 3.0 KNM²
Roof – snow load: 0.75 KN/M²
Loadings, and beam spans can in particular circumstances be increased.

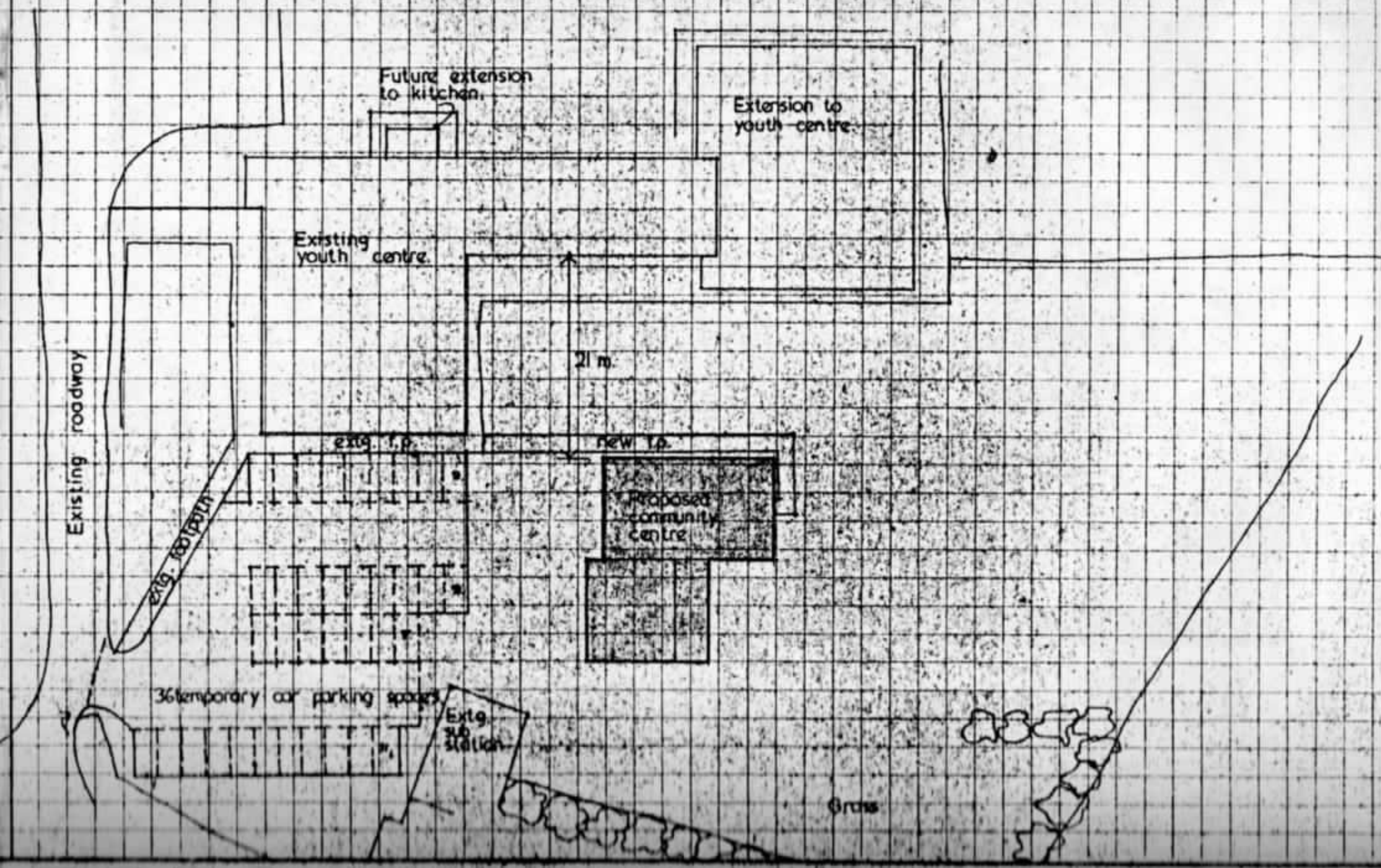




The manufacturer chosen was F. Pratten & Co. Ltd., of Midsomer Norton, to supply the "Freeplan" system. A standard 1.8m module was found to be suitable and no amendments to the standard components were necessary, nor was the design of the building dictated to a great extent by the components involved. Basically, the structure is load-bearing timber frame panels, some including window and door openings, on a traditionally constructed concrete base, with a flat roof of stressed-skin plywood panels supported by light-steel roof trusses. All superstructure components are prefabricated. The total floor area is 3,800 ft^2 and the total estimated cost of the project is £21,882. This money has been raised in a variety of ways: Avon County provided £6,250, the Parish Council £2,500, the County Council £1562, the District Council £1,200 and Association fundraising provided the residue. There is no doubt about the building being cheaper than a traditionally constructed one: the superstructure will be approximately 15% cheaper.

Although there was no difference with regard to time in the administrative stage compared to a traditional building, the architect without consulting the rest of the group, decided to turn the whole building, on plan, through 180° (see site plan). The reason for this was that previously, the theatre backed onto a youth centre and it was felt that noise from the youth centre would be distracting for activities in the theatre, but now the situation is reversed, as well as the building: the theatre now gives onto a row of existing houses some 15 metres away at which, even with a protective screen of trees, the maximum noise limit will be 50d.b., which could seriously limit the use of the theatre for dances, concerts etc.

Site Plan.



Future extension
to kitchen.
Extension to
youth centre.
Existing
youth centre.
21 m.
Existing roadway
extg. f.p.
new f.p.
Proposed
community
centre
extg. footpath
36 temporary car parking spaces
Extg.
sub
station
Grass

The substructure, for which 40% of the labour has been skilled and the rest volunteer, has taken 3 months to complete (see photograph). At the time of writing, this is the point reached, and the superstructure will take 6 weeks to erect, using 100% professional labour, specifically supplied by Prattens for the purpose, and the last stage, that of applying the internal finishes, will take a further 6 weeks, again using volunteer labour. Although it seems like the substructure tood a disproportionately long time to complete, it must be remembered that volunteer labour can usually only work in evenings and weekends and in suitable weather conditions, whereas, once the building is enclosed, the internal finishing can proceed apace, and it is also not as arduous a task as preparing a foundation slab.

So far, apart from the complete reversal of the building, no particular problems have arisen and the only main consideration concerning the substructure was that it should be more accurately laid than that for a traditional building, due to the inclusion of metal ties, to which the wooden cills on which the panels sit, are connected. After that, especially using a "closed" but flexible system of construction, no problems should be encountered. The information included here was kindly provided by F. Pratten & Co. Ltd., J.A. Powell (architect) and V. Reeves (ex vice-chairman).

In the last chapter, I will attempt to conclude what the position of the Building Industry with regard to the use of prefabricated elements will be in the future, drawing on the aforementioned and additional information.

Chapter 4: CONCLUSION

At the present time (i.e. within the last ten years or so) there have evolved three quite clearly defined areas of opinion as to the future of the Prefabricated Building Industry:

(1) It will stay basically as it is, but with gradual innovations and improvements.

(2) Our culture (that of the Western World) will become dominated and substantially changed by the philosophy of plug-in, clip-on "living structures".

(3) The situation will go into reverse and we will gravitate back towards a slower, more personalised craft-based approach.

It is possible to examine these three projections separately, but I must state my personal opinion now, that I believe that the first alternative will be the case. From my observations of the Building Industry and the World in general, I would surmise that continual improvement is necessary and must, and indeed will be supported, but it will not be allowed to reach the point where mechanisation becomes a philosophy unto itself ("Mechanisation takes command" although the title of Giedion's book is not intended to mean what it does in this context). The RIBA, that great bastion of British Architectural discipline, assumed that this first alternative would apply in their 1963 report, outlining ways in which the industry as it then stood could be improved, basically through the use of better organisation, better communication and improved techniques - there was no desire for a "total environment" in which industrialisation was dominant, but an improvement in our environment, with greater internal and external

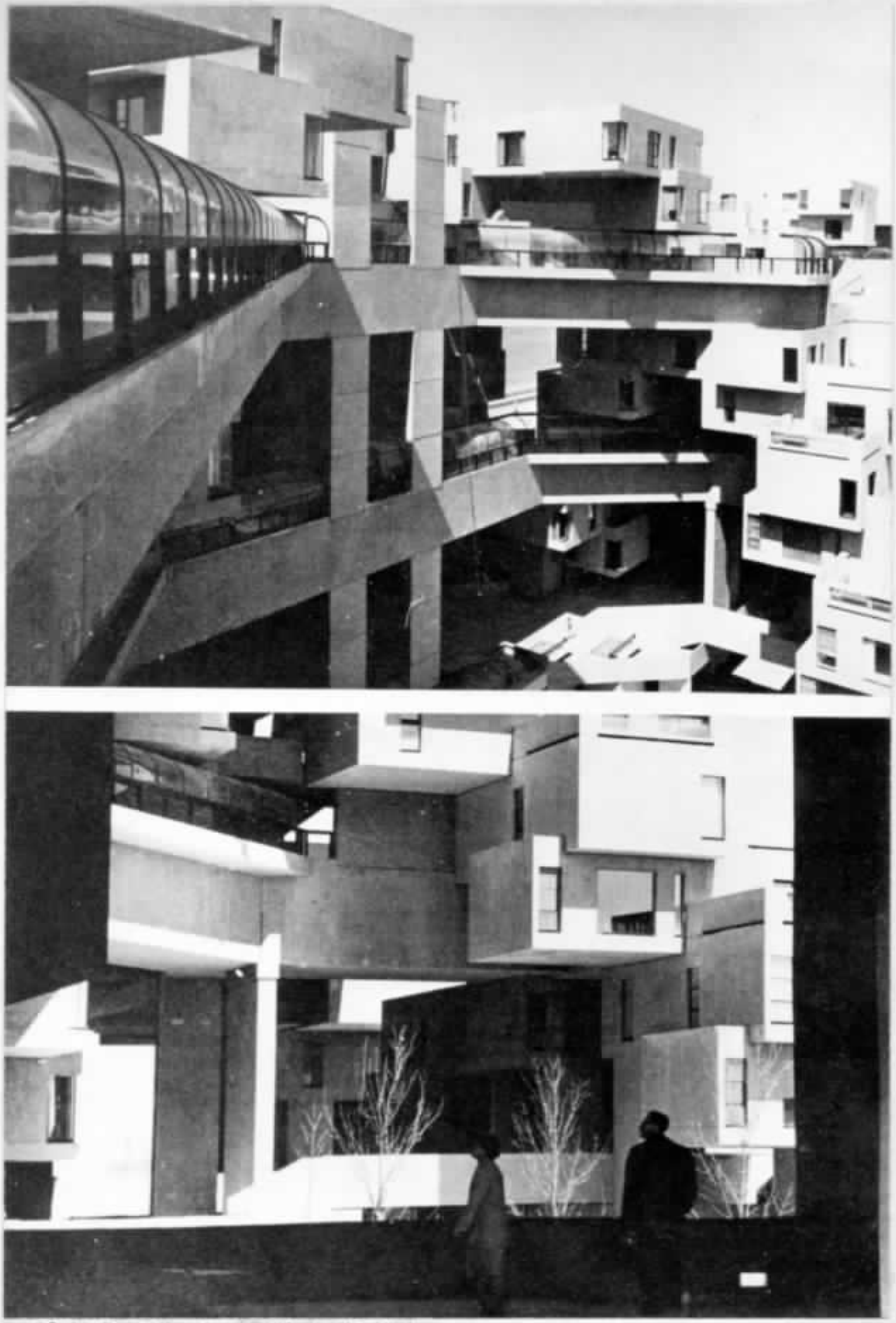
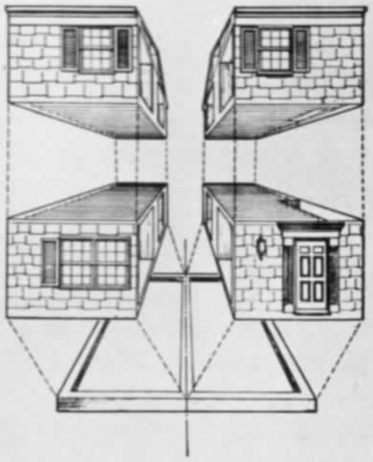


Plate 5: Moyshe Sadfie's Habitat

flexibility in our structures through the use of standard ranges of freely interchangeable, modular co-ordinated components. This opinion was somewhat borne out by an American, (although it must be remembered that the American building industry is substantially different from that of this country), Alan E. Brockbank, 1961 President of "Continental Real Estate and Insurance Co", when he said "...Today, I would say that if we are using component parts by 10 years from now throughout all the houses in this country (U.S.) I will be greatly surprised. My reason for this pessimistic view is that the savings we expect to make by the mass production of components seems to be eaten up by the excessive cost of production and transportation...."

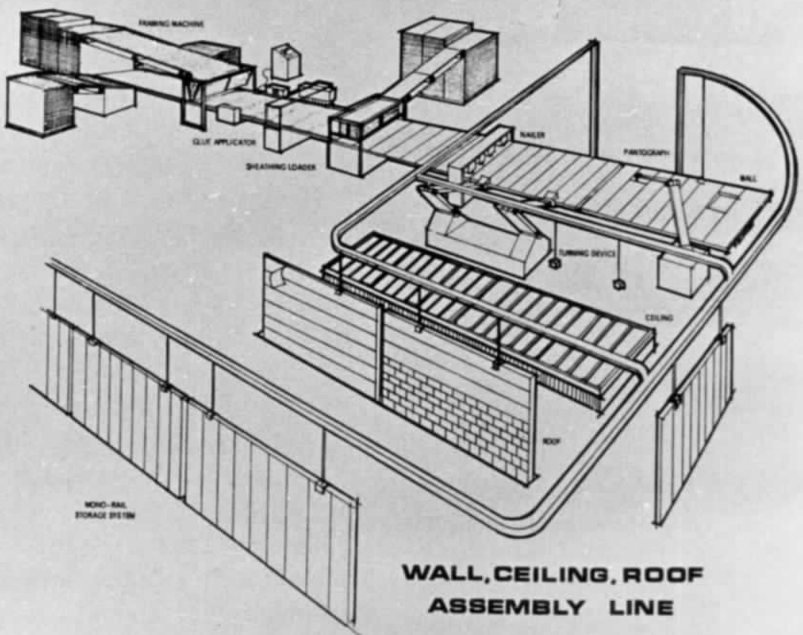
The American scene is illustrated quite well by Richard Bender in his book "A Crack in the Rear-view Mirror", in which he sets out the materials and techniques available to the building process, with timber playing a major role. He puts forward the concept of a "miscellaneous file" in which information on materials and methods, the structure of the industry and "bits and pieces" which are outside the accepted ways of building has been stored by architects and the like. He then goes on to envisage three scenarios for the future. The first is that of "The Housing Factory", in which houses are built by an automated process on a par with car production and makes the illustration clearer, imagining the construction of a car by the same methods by which a car is built now. "The housing factory is seen as an element of a large system which included food, clothing, aircraft, communications and recreation facilities as well as land, appliances and building materials. This broad view of housing as part of a "shelter industry"

Automation in Housing



Schematic of four-part module home section of Levitt townhouse.

Townhouse built by factory assembly line methods will appear as this Levitt prototype. Units will cost $20-$25,000 each and will be initially marketed in Detroit, Chicago, Toledo and Cleveland, O.



Production line for parts of Levitt homes begins with raw materials and ends with finished components for modules. Units will be marketed to surburan areas first than to city-dwellers. Transportation costs are estimated at 75¢ to $1 per mile.

Homes to Roll Off Levitt Assembly Line

Factory-built homes will roll off a Levitt assembly line in the near future. Announcing this intention, Richard M. Wasserman, president of Levitt and Sons, Inc., said the company had formed a new subsidiary, Levitt Housing Systems Corp., to produce the homes in a plant at Battle Creek, Mich.

Charles L. Biederman has been named president of the new division. He said, "Levitt can best maintain its leadership in the home building industry by using new construction methods. Factory-built housing will enable us to draw on the semi-skilled labor pool and provide them with careers that will be profitable and secure.

"Moreover, we will maintain our ability to provide a quality home priced within the means of the moderate-income American."

The first units designed for production are townhouses upon which a 2½ year feasibility study was recently completed. Currently, studies are underway for apartments, multi-story buildings, motels, and vacation homes. The townhouses will be on permanent foundations, meet local building codes and zoning requirements and will be comparable to site-built units in structural aspects.

The Battle Creek, Mich., house factory will have a floor area of 140,000 sq. ft. The first units are expected off the assembly line in late fall, 1970, at a rate of 2,000 dwelling units per year with one work shift.

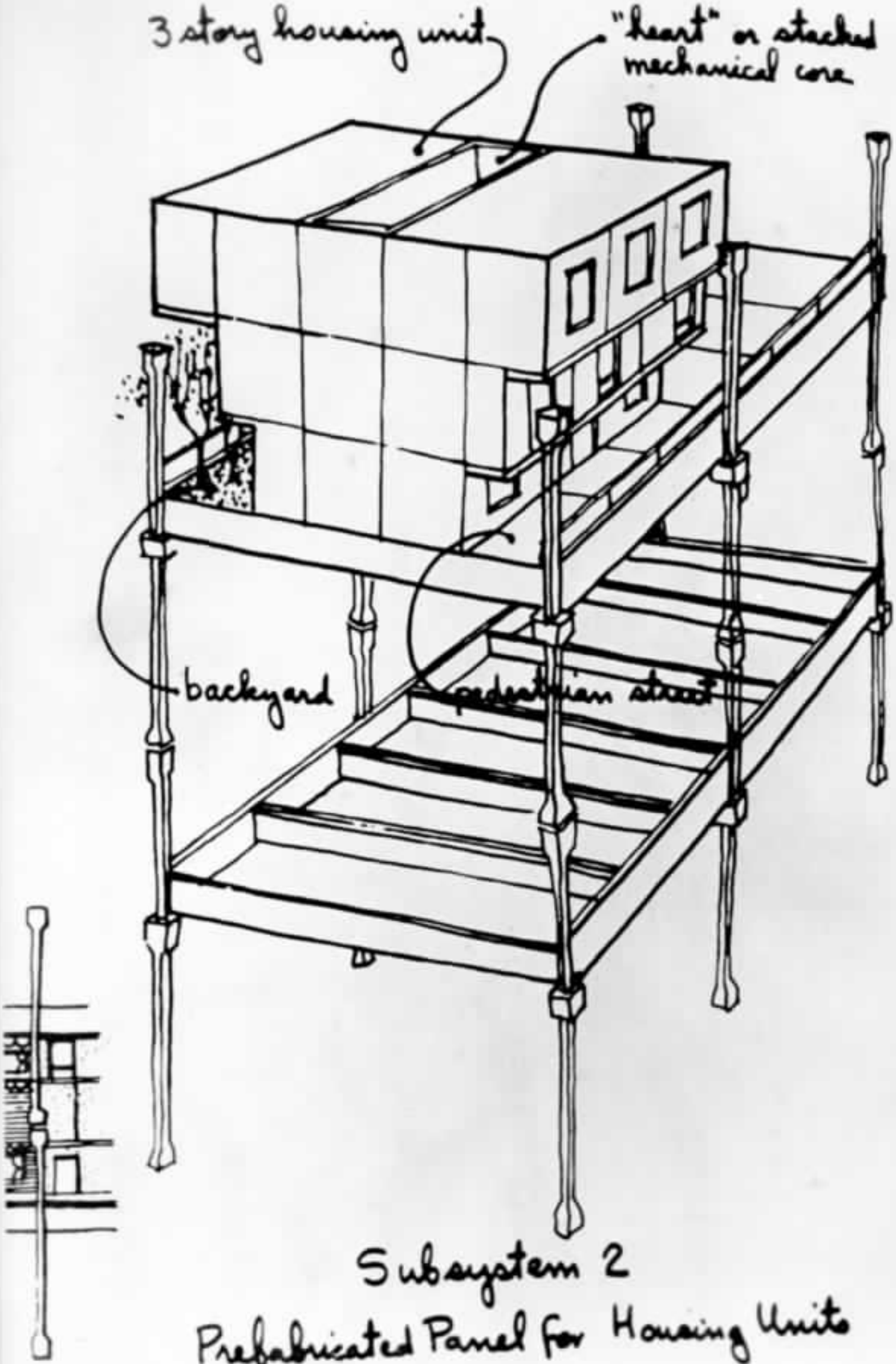
Wasserman interjected the comments that, "Sectionalized housing can be a definitive step forward in reducing the housing crisis of the 70's . . . . help solve our present shelter dilemma by providing quality housing at moderate cost."

Plate 6: American automated housing

moves towards our second scenario. The first scenario, however, is the housing factory. It has all the elements of what we have come to understand as industrialised building". The second scenario is that of the development of large-scale, systems-oriented life service industry, but to clarify it: "Since the bulk of what arrives at each house eventually leaves as solid waste, why can't the truck which makes department store deliveries also remove garbage? Since packaging decisions are part of the solid waste disposal problem, should we consider them together? Can new bicycles be packed in dog food, fertiliser or fuel?" Although it is hard to see the connection in the last example, the general concept is very interesting and should be given some thought, although it would be difficult to achieve such direct results as those illustrated. "The "system" view will make it clear that the problem involves much more than hardware production. Ultimately, it depends upon the techniques of organising and managing the process itself, and cannot exist where product initiation, design, manufacturing and marketing are isolated forces."

The third scenario is one which is similar to my first area of opinion: "We are inventing a kind of "automated cottage industry", where homemaking is meant to be part of daily life". This scenario does not suggest a retreat from industrialisation - it simply calls for another model - a new building industry that would be responsible for the manufacture and distribution of components rather than finished houses. "The critical function of this new industry would be the operation of an information and distribution system".

Another idea was put forward by Martin Pawley, in "Architecture



Subsystem 2
Prefabricated Panel for Housing Units

Plate 7:

versus Housing" - that of "technological super-humanism", a term invented by Pawley, to illustrate the only group of architects and students in the last decade which has come within striking distance of "the massive change in life-style so evident in the activities of the young today". This group, apparently, has a kind of "absolute faith in technology as the natural tool of Western man". The technological super-humanists see mobility as an end in itself, which puts them within range of the growing Hippie subculture, whose "transient gatherings and itinerant life-style" became more clearly defined towards the close of the '60's. All this might have seemed perfectly feasible back in the heady '60's, but, since then, World economy has become increasingly more uncertain, and, although that situation might seem to engender itinerant counter-culture, most people at the forefront of these "alternative societies" do become incredibly "normal" as time goes by, just through trying to live a fairly "normal" existence, and it is only a committed few who retain their original strength of belief. I think it will be a very long time before a culture strong enough to challenge the establishment in the West emerges, if at all.

The third alternative in the progression of the Building Industry is that it will gravitate back to one based much more on the individual, personal crafts, similar to what was advocated by William Morris, around the turn of the century. I think it could have succeeded then, had it received enough support, but, apart from prevailing world economics, I do not think a total return to crafts is possible. It is apparent that the massive increase in industrialisation and prefabrication predicted in the '50's and '60's just will not happen (see letter

The Secretary
Architectural Association
34-36 Bedford Square
London WC1

18 March 1976

Dear Sirs

I am a third year student in Construction at Bristol Polytechnic, Faculty of Art and Design, and I am writing my thesis on 'Prefabrication in Building'. In a RIBA report of 1963 entitled 'The Industrialisation of Building' there is a section to the effect that possibly, in the future, teaching in Architectural Colleges would contain more concerning the significance of industrialised components in building. Not necessarily to engender a 'blanket' appreciation, but to create a greater consciousness of how and for what reasons prefabricated building methods should be used. I would be grateful for any comments you could give me concerning the present and possible future situation.

Yours faithfully

Jon Risdon

Jon Risdon
Third year student
School of Construction

ARCHITECTURAL ASSOCIATION SCHOOL OF ARCHITECTURE

Chairman: Alvin Boyarsky, B.Arch (McGill), M.R.P. (Cornell), M.R.A.I.C.,

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Jon Risdon
Third Year Student
School of Construction
Bristol Polytechnic
Clanage Road
Bower Ashton
BRISTOL BS3 2JU

23rd March, 1976.

Dear Jon Risdon:

"Industrialisation of Building"

Your letter of 18th March has been forwarded to me for reply.

In 1963, when it seemed as if there was to be a future of endless growth and rapid construction, the architectural profession was predicting that industrialisation would be a major approach to dealing with the demands on the building industry. Today, alas, we are more than aware that resources are fewer and more difficult to come by and that massive rapid building involving prefabrication techniques are no longer economically viable, nor is there evidence that the environment has been appreciably improved in the last decade using these means.

I think that it is important for students in the construction schools to take a careful sounding of what the priorities are for the near future. Many people feel that the days of urban renewal, mass construction are over for some time to come and that what is required is to resuscitate the small building industry, including conservation and infill techniques, signifying a return to the old fashioned building trade and traditional materials and conservation of energy and other resources.

I hope that the above advice has not been too deflating and pessimistic for your tastes.

Yours sincerely,

Alvin Boyarsky
Chairman

from Architectural Association). This does not mean that the Prefabricated Building Industry will go into decline - quite the opposite, I think it will continue to expand gradually, more in the direction of "open" systems which can be applied to schools, public buildings, factories, warehouses, etc., but I think that as far as housing is concerned, prefabrication will never take over completely from traditional building techniques purely because people in general prefer individuality and a feeling of substantiability which enough are prepared to pay for in spite of the possible economy of prefabrication, and there will never be sufficient investment in component manufacture, mainly because of the stop-go manoeuvring of successive Governments. It is possibly a shame but still - Vive la difference!

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