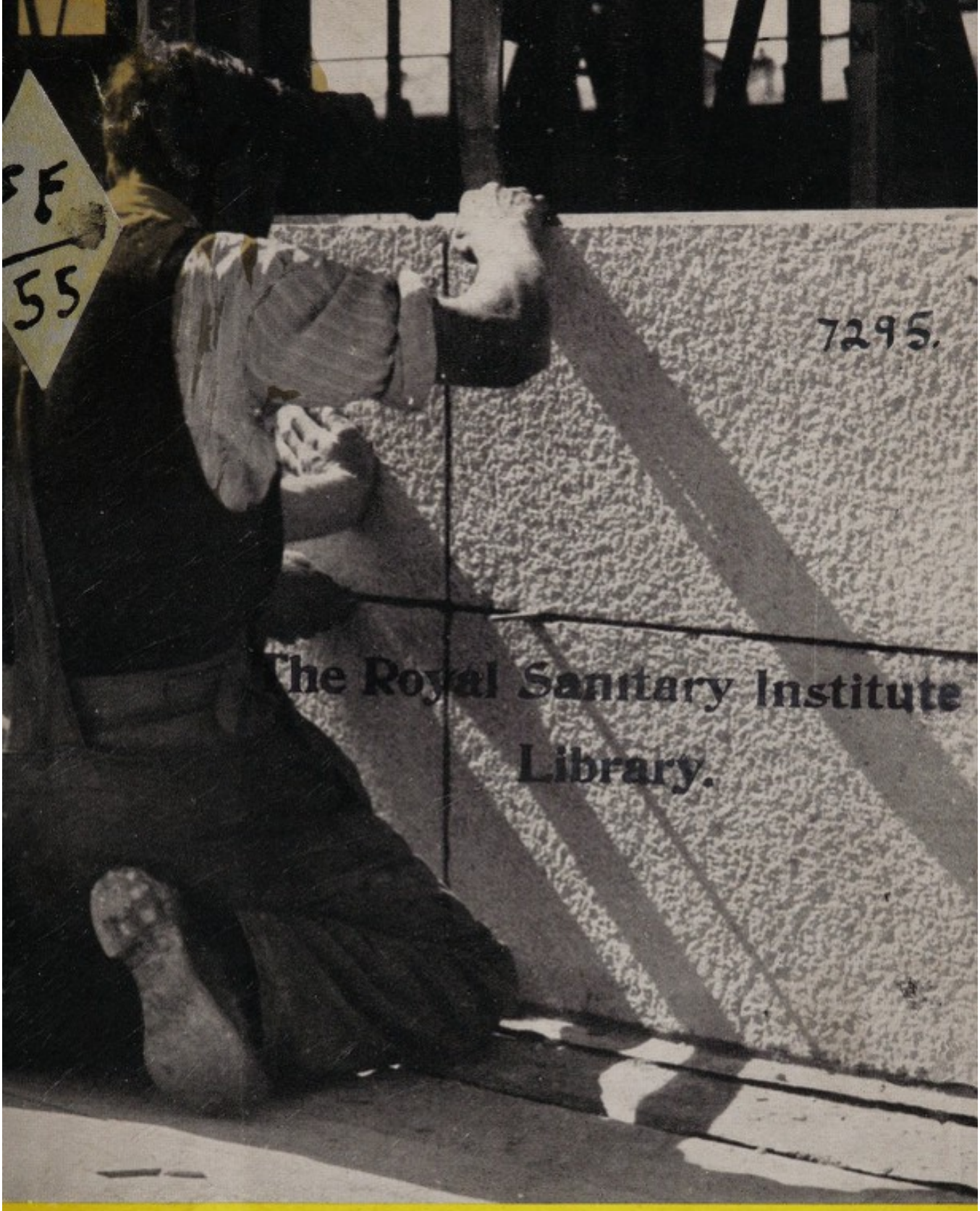
Demonstration houses : a short account of the demonstration houses & flats erected at Northolt / by the Ministry of Works.



DEMONSTRATION HOUSES

LONDON: HIS MAJESTY'S STATIONERY OFFICE 1944

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DEMONSTRATION HOUSES

A Short Account of the
Demonstration Houses & Flats
erected at Northolt by the
Ministry of Works

LONDON
HIS MAJESTY'S STATIONERY OFFICE

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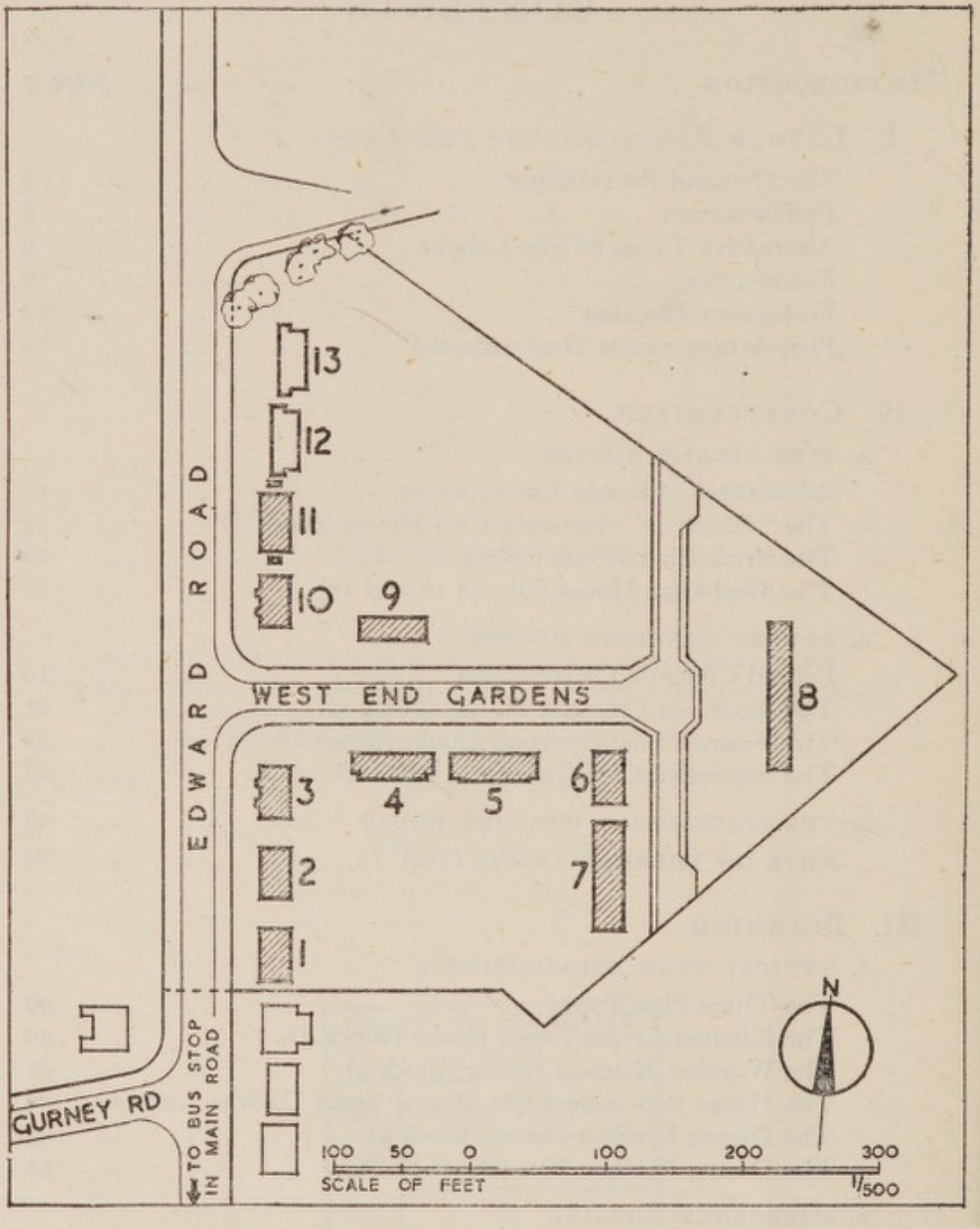
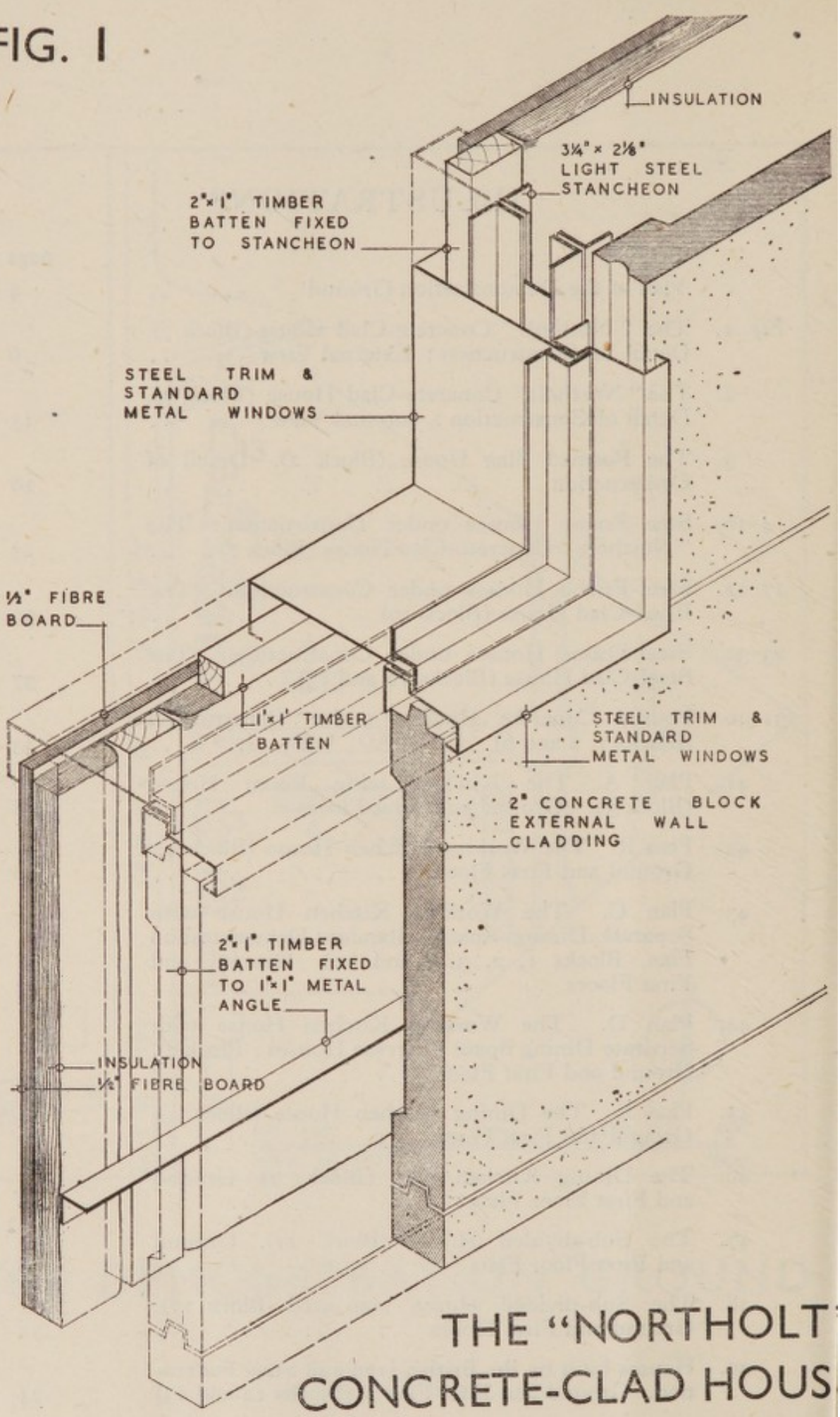


THE DEMONSTRATION GROUND

ILLUSTRATIONS

FIG. 1



THE "NORTHOLT
CONCRETE-CLAD HOUS

INTRODUCTION

1. THIS BOOKLET gives a short account of a series of houses built on the Ministry of Works demonstration ground at Northolt, Middlesex, for the purpose of estimating probable post-war costs for methods of house building advocated in *Housing Manual* 1944.* Particulars of the demonstration ground will be found in Appendix B.

2. The thirteen blocks of demonstration houses fall into two groups. In the first group are those built by special methods and in special materials, such as will be required to utilise more fully, and to some extent to supplement, the resources of the building industry during the years immediately following the end of the war in Europe. The seven blocks in this group are dealt with in Section II. The other six blocks form a group of demonstrations embodying recommendations as to internal planning and arrangement, including a demonstration of a method of emergency housing. These six are built of brick in the traditional manner. Plans and descriptions will be found in Section III. One of the blocks in this last group (Block 3) has been built to the same plan as that used for the houses in the first group built to demonstrate the alternative methods of construction. A standard, or control, is thus provided to measure the relative costs of these less familiar methods as compared with traditional brick building.

3. So that the demonstration houses may present a complete picture, including the total cost of building and equipment, each block is finished with installations and equipment, including heat appliances and cupboards. These appliances and pieces of equipment should not be regarded as part of the demonstration, which is concerned only with the capital cost and building labour requirements of houses of certain types and sizes and using alternative materials and methods of construction. Recommended standard equipment for post-war housing was illustrated in an exhibition dealing solely with this subject.

4. All but two of the blocks (12 and 13) of demonstration houses were built by the Ministry of Works to the designs of Mr. C. J. Mole, F.R.I.B.A., Director of Works, with Mr. A. W. Kenyon, F.R.I.B.A., as consultant. The Minister was also generally advised by a panel of architects appointed at his request by the President of the Royal Institute of British Architects. The panel consisted of Mr. T. Cecil Howitt, F.R.I.B.A., Mr. C. H. James, A.R.A., F.R.I.B.A., and Mr. L. H. Keay, F.R.I.B.A. In the design of the two-storey block of flats (Block 7) Mr. Mole worked in close collaboration with Mr. Keay. The houses in Blocks 12 and 13 were built by the British Iron and Steel Federation; the architect was Mr. Frederick Gibberd, F.R.I.B.A., M.T.P.I.

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* *Housing Manual* 1944. H.M. Stationery Office. 2s. net. (by post 2s. 2d.)

I. LABOUR REQUIREMENTS AND COSTS

THE DEMAND FOR BUILDING

5. It has been estimated that four million new houses will be needed in a period of between ten and twelve years immediately following the end of the European war. While these houses are being produced, other heavy burdens will fall upon the building industry. Several million houses and other buildings damaged by enemy action will have received only temporary repair; these buildings must be made permanently sound at the earliest moment if worse damage is not to ensue. A six-year accumulation of deferred maintenance will also have started a process of deterioration which cannot be allowed to go unchecked. In addition, many new buildings other than houses will be required : schools and school extensions necessary for the operation of the Education Act; factories and other buildings to feed our all-important export trades; and the farm buildings without which we cannot hope with a peace-time rural labour force to continue to produce food from our own soil. If these results are to be achieved, it is essential that the maximum output and efficiency in building should be secured by all possible means.

6. The Government have indicated their general intention with regard to the size of the building industry after the war. But it is clear that, even under the most favourable circumstances, industry will not be able to meet the unprecedented demand without making use of all alternative methods of construction. The demonstration houses of 900 sq. ft. area built at Northolt by traditional methods require some 2,400 man hours of building labour employed on the site. It is necessary that means should be developed of building other types of satisfactory houses for which the building labour required on the site is very substantially less. Something can be done to reduce the number of man hours by increased efficiency, but the present efficiency of the industry is such that only a small reduction is possible by such means. A material saving can only be achieved if factory work, as now exemplified in the production of joinery units, can be called upon to a far greater extent than it has been up to the present.

PREFABRICATION

7. To illustrate what can and must be done to secure a substantial contribution from industries outside the building industry, the Ministry of Works has erected the two-storey "Northolt" concrete-clad block of flats (Block 7). The average floor area of these flats is 900 sq. ft., and, as will be seen from Tables I and II, the saving in man hours of building labour on the site is considerably more than one half. This result was obtained by the extensive use of prefabricated parts, including wall slabs and linings, standard floor and ceiling panels, partition units complete with doors, and cupboard units serving as internal partitions, and by the incorporation of plumbing and electrical services in larger composite

units delivered to the site ready made. It should be noted that though the block as built is, in fact, a block of four flats, the same system of prefabrication would be applicable in precisely the same degree to a block of ordinary houses, with results little different from those here shown. This is briefly referred to as the " Northolt " concrete-clad block.

ALTERNATIVE TYPES OF SITE LABOUR

8. If the fullest and most effective use is to be made of the available building labour, the various trades employed must be given every facility for developing their full capacity and earning power. This will not be possible so long as there is a risk that the work of one trade may be obstructed or delayed by difficulties in another trade. Houses built of brick with timber floors, and having a " pitched " or sloping roof covered with tiles or slates, are still regarded as the norm, and the great bulk of the houses to be built under the 10-12 year post-war programme may be expected to be of this type. Concretors, bricklayers, carpenters, tilers, plumbers, plasterers, gas fitters, electricians, painters and other building craftsmen are needed to build a house of this kind. Should a temporary shortage of any one of these trades occur in any particular place, it would impede the operations of other trades and cause a setback in the production of houses. The Government accordingly caused the study to be undertaken of methods of building using materials other than those of the ordinary brick-built house, and less dependent on the "key" trades of normal house building. Some tens of thousands of houses were built after the last war in concrete, timber, steel and other such materials, and the best of the systems employed were reviewed in the light of the experience of twenty years and more. The results of these investigations are contained in the report *House Construction** published in March 1944.

9. Apart from the saving in the total amount of building labour on the site, the concrete-clad dwellings (Block 7) obviate plasterers' labour and require only a small amount of bricklayers' labour for the setting up of the prefabricated concrete flues, concrete-block cladding, party wall and staircase wall. For the three blocks having poured concrete walling (Blocks 1, 2 and 6) the amount of bricklayers' labour was also small, but in this case the external rendering caused a greater call to be made on plasterers' labour than is made in the ordinary brick-built house. The steel-frame brick-clad house (Block 10) showed a small saving in bricklayers' labour due to the substitution of clinker blocks for bricks in the construction of the inner skin. The steel-frame houses generally increased the efficiency of the building labour employed, more particularly in that they allowed the roof to be covered at once, so that after the first week the effect of bad weather on all trades was reduced to negligible proportions.

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* *House Construction.* H.M. Stationery Office. 2s. net (by post 2s. 2d.).

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10. Since the various types of construction for demonstration houses are each suited to particular circumstances, which are bound to occur in certain places and at certain times, the ideal housing programme should include an admixture of all these methods.

FOAMED SLAG

11. Table I shows that, apart from the " Northolt " concrete-clad block (Block 7) in which prefabrication methods were extensively used, the nearest approach to the cost of the brick-built control house is found in the house built of foamed slag concrete. The cost of the foamed slag concrete house as here estimated is contingent upon the development of foamed slag production by the steel industry.

12. The Minister of Works has had considerable discussions with the steel industry as to the prices at which foamed slag could be made available and which would ensure the cost of houses of foamed slag concrete being comparable with that of brick houses. These prices will not obtain unless there is a considerable demand for the material. What is needed to ensure a steady output of foamed slag at the right price is a steady and sufficient demand. Local authorities and builders within a 50-mile radius of steel-producing plant will find a study of the possibilities of this material amply repaid. Full information may be obtained from the Secretary of the Foamed Slag Committee, Mr. C. R. Wilkinson, at Steel House, Westminster, London, S.W.1.

TABLES I AND II

ESTIMATED IMMEDIATE POST-WAR COSTS

Notes

1. The figures given in Tables I and II are based on actual labour and material costs of individual blocks of dwellings as built, adjusted as necessary for contracts of 500 houses.

2. Labour is included at London rates of wages (craftsmen 2s. 1½d., labourers 1s. 8d.).

3. The net cost figures are for labour and materials only. The gross cost includes overtime and Sunday work, travelling time and expenses and subsistence paid by Ministry of Labour. Both net and gross figures are exclusive of profit and overhead costs.

4. The costs include the installation and equipment, with the exception of the gas or electric cookers provided in most of the blocks. The cost of the refrigerators, electric light fittings, gas and electric fires where fitted is also excluded.

5. The cost of the expanded clay house (Block 6) is not included in Table I as it seems unlikely to prove economical. The steel-clad houses (Blocks 12 and 13) are not included as they are not comparable either in plan or in equipment.

6. For Block 8 the figures given are for the house illustrated in Fig. 44.

TABLE I.

HOUSES DEMONSTRATING METHODS OF CONSTRUCTION

BLOCK NO.	TYPE OF DWELLING	HOUSE PLAN	TOTAL FLOOR AREA	BUILDING LABOUR	NET COST		GROSS COST
					TOTAL COST	COST PER SQ. FT.	
			Sq.ft.	*Man-hrs.*			
7	The "Northolt" Clad Block	F	900§	900	£730	16s. 3d.	£755
1	The No-fines Concrete House	C	850	2,190	£770	18s. 1d.	£825
2	The Foamed-Slag Concrete House	C	850	2,175	£760	17s. 10d.	£815
10	The Brick-Clad House	C	862*	2,080	£780	18s. 1d.	£835
3	The Brick-Built Control House	C	862*	2,050	£759	17s. 7d.	£815

TABLE II.

HOUSES DEMONSTRATING PLAN ARRANGEMENTS

BLOCK NO.	TYPE OF DWELLING	HOUSE PLAN	TOTAL FLOOR AREA	BUILDING LABOUR	NET COST		GROSS COST
					TOTAL COST	COST PER SQ. FT.	
			Sq.ft.	*Man-hrs.*			
5	The Kitchen-Living Room House† ..	A	900‡	2,470	£850	16s. 5d.	£910
9	The Working Kitchen House	B	850	2,030	£740	17s. 5d.	£790
3	The House with Separate Dining Space (Standard Demonstration Plan) ..	C	862*	2,050	£759	17s. 7d.	£815
8	The House with Separate Dining Space (Terrace House)	D	864§	1,935	£750	17s. 4d.	£800
4	The Dining Kitchen House	E	900‡	2,425	£830	17s. 0d.	£890
7	The Dining Kitchen Flat ..		900§	900	£730	16s. 3d.	£755
11	The Sub-divided House (total figures for two flats of 400 and 500 sq. ft. floor area respectively)		900‡	2,760	£920	19s. 0d.	£995

* Including bay window.
† Costs include solid fuel burning cooker.
‡ Plus outbuildings.
§ Average.

EMERGENCY HOUSING

13. A contribution towards the four million new houses may have to be sought in some form of emergency housing other than the temporary houses. Various proposals have been advanced for the building in permanent materials of dwellings offering sub-standard accommodation, but designed for rapid and economical conversion to full standard dwellings at a later date. Generally, these proposals have shown a saving in building labour as compared with the normal, full-standard house, but the saving is limited, since it can only be achieved at the direct expense of living space. The most interesting of these proposals has been given practical demonstration in Block 11. Each of the two houses in this block – a normal three-bedroom house of 900 sq. ft. floor area – is so designed that it may be used during the emergency period as a pair of flats. One house is built thus sub-divided (*see* Fig. 47); the other is shown converted to its ultimate use as a single family dwelling (*see* Fig. 48).

14. For Block 11 the cost of building is set out in Table II; the estimated net cost of converting each pair of flats into a house is £77 per house, at present prices.

PLAN ARRANGEMENTS DEMONSTRATED

15. As has been mentioned, five blocks of demonstration houses have been built to illustrate recommendations as to planning. These recommendations were made by the Central Housing Advisory Committee of the Ministry of Health. They are set forth in the report *Design of Dwellings** and to a large extent were adopted in *Housing Manual* 1944. The kitchen-living room house (Block 5) and the dining kitchen house (Block 4) show, each in its particular way, how the recommendations may be given effect in a house having a total floor area of 900 sq. ft. Working kitchen houses, with and without a separate dining space, have also been built; these have a floor area of 850 sq. ft. All the demonstration houses are three-bedroom houses designed for a household of five, which is regarded as the normal; but the block of four flats (Block 7) includes two flats for households of six. All the houses and flats have two good rooms on the ground floor with the exception of Block 9, which illustrates the advantages of the single large living room. Costs and man-hours of site labour are given in Table II (p. 11).

* *Design of Dwellings*. H.M. Stationery Office. 1s. net (by post 1s. 2d.).

II. CONSTRUCTION

A. STEEL-FRAME HOUSES

ADVANTAGES OF FRAME CONSTRUCTION

16. Houses built with a frame of steel or other suitable material offer considerable advantages, which may be summarised as follows:
a. The frames and cladding together with the floor units may be standardised and prefabricated.
b. The external and internal cladding may be lightened and may be varied as required to avoid whatever shortage of types of labour or material may exist in the district at the time of building. Concrete, brick, steel and rendered claddings were used for the demonstration houses.
c. If the roof is covered immediately the frame has been built, the operatives are protected from the weather and work may be continued on wet days.
d. The frame acts as a template which, once it is completed, obviates further need for levelling, plumbing and alignment.
e. After the frame is erected, work on flues and on external and internal cladding may proceed at different levels simultaneously.
f. Since most of the loads are taken by the frame, structural lintels over ground floor windows or other openings can be reduced to a minimum.
It may be found that these advantages where they are fully exploited will outweigh any additional cost which may be incurred by the use of a steel frame. Whether in fact they do so must depend on local circumstances at the time of building.

THE CONCRETE-CLAD HOUSE

17. A two-storey block of flats (Block 7) was built to demonstrate a method of construction, showing the very considerable extent to which methods of standardisation and prefabrication can now be applied. The idea is adaptable to more than one plan or size of dwelling and to more than one type of cladding, is economical in labour and materials, and at the same time maintains high standards of efficiency and permanence. But it must be emphasised that this block is only an example of a general line of approach to house building, which may be pursued in many different ways to achieve the same or better results. The external cladding used in this case is of precast concrete slabs. With the exception of the small amount of mortar used in the jointing of the cladding, the whole of the remainder of the construction was dry, and occupation could have taken place immediately on completion. The block was erected in a total of 900 man hours per dwelling, as compared with 2,050 man hours, the estimated number for a comparable house or flat of normal brick and timber construction.
18. The surface concrete slab is 4 in. thick of the usual mix, laid on hard core.

19. The frame is of light fabricated steel sections. The posts are built up from four 1 in. by 1 in. angles welded to $\frac{1}{8}$ in. plate webs spaced at intervals to form an H section. The ground and first floor beams are built up from two $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. tees welded to $\frac{1}{8}$ in. plate lattice web to form an H section. Light king post trusses composed of members of construction similar to the beams form the framework for a pitched roof with hipped ends. The whole frame, which was treated with a coat of bituminous paint before delivery, is designed for erection on site by bolted connections, the only erection plant required being a pole and blocks and tackle for hoisting. The posts in the external walls on the longer sides are spaced at 3 ft. 4 in. centres and carry the floor beams and trusses; the first floor beams are supported centrally on posts of smaller section. Softwood battens to which the lining materials are to be fixed are attached to the posts, beams, and trusses before delivery to site. The eaves, fascias and soffits are of sheet metal in 10 ft. lengths (*i.e.*, three bays) fixed to the steel frame.

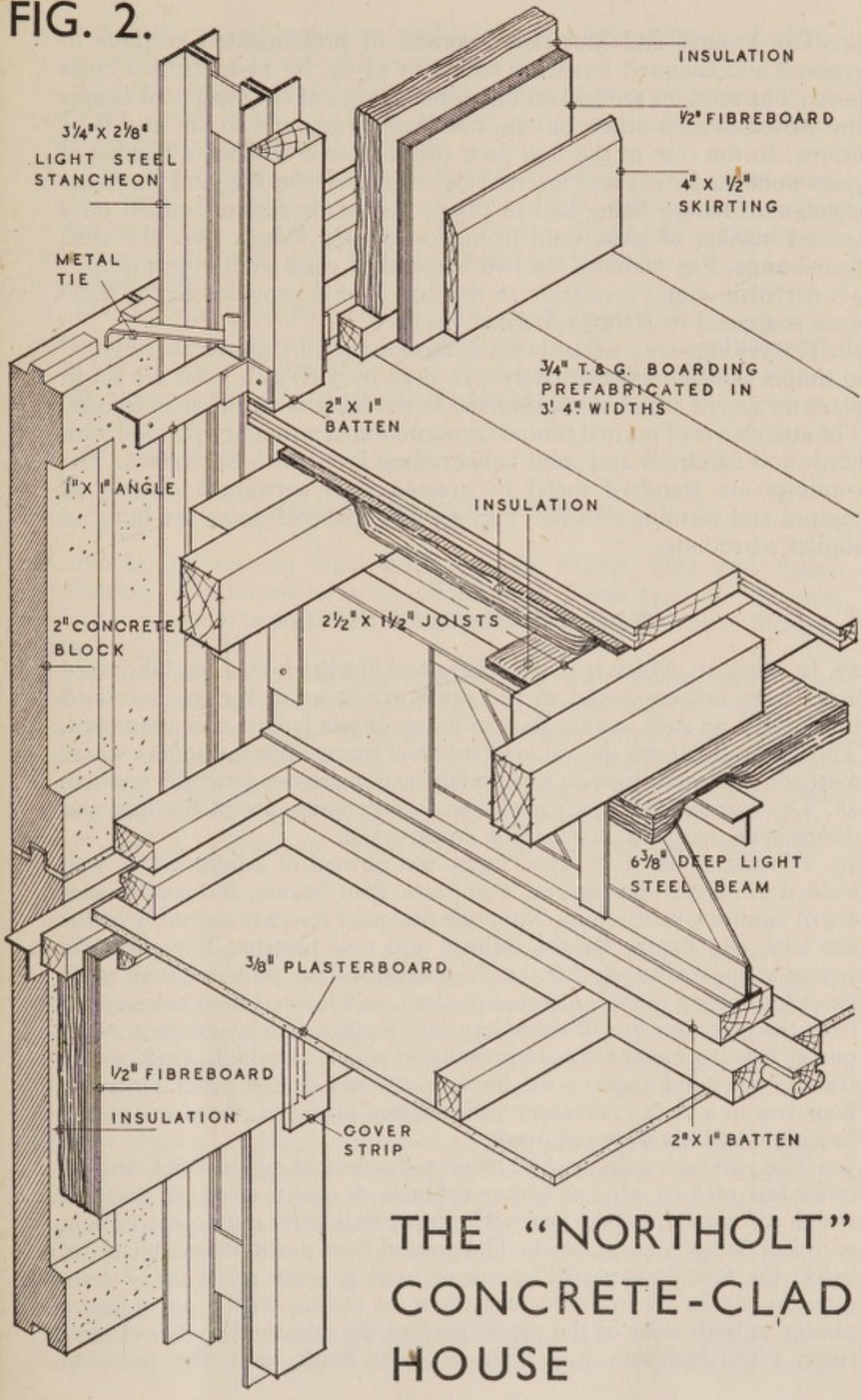
20. The isometric drawings (Fig. 1 and Fig. 2) show in detail the method of cladding, flooring, insulation and window framing. The external cladding consists of vibrated concrete panels having an integrally cast external coloured finish. The panels are 2 in. thick, 3 ft. 4 in. long and 1 ft. 4 in. high, laid with straight horizontal and vertical joints bedded in cement mortar; they are attached to the steel columns by galvanised steel ties bedded in the joints, and are insulated from direct contact with the posts by damp-proof felt strips (not shown in the drawings). The party wall is built of two leaves of 3 in. clinker concrete slabs with a cavity which contains steel framing and bracing giving rigidity to the frame.

21. The internal cladding to the external walls is composed of a 1 in. lining of glass wool blanket with a finishing surface of $\frac{1}{2}$ in. fibreboard. This internal cladding is fixed to the softwood battens attached to the posts and given intermediate support by vertical battens set against 1 in. by 1 in. angles fixed horizontally between the post battens. The 3 in. cavity between the external and internal cladding accommodates the steel frame.

22. The flues are 8 in. in diameter formed in concrete blocks and have an integrally cast aluminous cement lining. Where the stack is exposed above the roof the flue blocks have an integrally cast coloured external finish similar to the external cladding panels.

23. The internal partitions are composed of prefabricated timber framed panels, 3 ft. 4 in. wide and room height, with a finish of $\frac{1}{2}$ in. fibreboard pressed and glued to each side. The edges of the timber frame are grooved to receive the wooden rods by which the panels are fixed to each other and to floor and ceiling runners. Standard flush type wood internal doors are hung in special partition panels. The staircase hall to the first floor flat is enclosed on the ground floor by a 3 in. clinker concrete slab wall and this, together with the party wall, is lined with $\frac{1}{2}$ in. fibreboard on battens. All joints between fibreboard linings and between partition panels are covered with hardboard strips. Thus the whole of the interior has a uniform wall finish of fibreboard.

FIG. 2.



THE "NORTHOLT" CONCRETE-CLAD HOUSE

24. The ground and first floors consist of prefabricated sections of grooved and tongued boarding nailed to 2½ in. by 1½ in. timber cross joists. The sections are laid on the upper flanges of the steel floor beams and nailed to each other, but are not fixed in any way to the steel floor beams. In the case of the first floor prefabricated sections a blanket of glass wool insulation was inserted between the boarding and the cross joists, and, before being laid in place, the sections were bedded on a second blanket of glass wool insulation draped loosely over the steel floor beams. Fig. 2 shows the two blankets of glass wool in position.
25. Airborne sound insulation to the first floor is provided to the standard suggested in *Housing Manual* 1944.
26. The ceilings are prefabricated in sections of ⅜ in. plasterboard glued to timber panels, approximately 4 ft. 0 in. by 3 ft. 4 in., and are set in place on special wooden guides fixed to the battens on the steel frames. The staircase is of normal timber construction of wrought softwood with hardwood handrails and solid balustrading faced with fibreboard. The windows are standard metal in pressed steel surrounds closing all cavities and forming sills (*see* Fig. 1). The external doors are hung in similar surrounds.

THE BRICK-CLAD HOUSE

27. In Block 10, which is also steel-framed but brick-clad, prefabricated units were not employed to the same extent as in the concrete-clad house, and no such saving in man hours of site labour was attempted. The house illustrates the value of the steel frame even for houses where methods of standardisation and prefabrication are not generally applied.
28. The foundations, footings and surface concrete are of the mix and dimensions usual for 11-in. brick construction.
29. The members of the steel frame are formed of a light lattice web welded to narrow flat flanges. The posts, floor beams, and roof trusses are of similar construction. They are designed for easy assembly at the site with clip fixings for the ceilings and roof battens. The posts are spaced at approximately 2 ft. 11 in. centres, and are provided with angle bases for bolting to the concrete foundations. The steel floor beams span from the posts to a line of secondary centre posts. During erection, temporary bracing members were introduced which, in a high wind, would transfer the wind loads on the frame to the end braced posts. Once the floor was in and the necessary stiffness was provided, these temporary bracing members were removed.
30. The external walls consist of an outer leaf of 4½-in. brick and an inner leaf of 2-in. clinker concrete block. A cavity of 3¼ in. was left which accommodated the posts. The party wall is of cavity construction, each leaf being of 4½-in. brick. The ground floor partitions are all 4½-in. brick; the first floor partitions are of solid gypsum made up of ¾-in. gypsum planks 18 in. wide from floor to ceiling with ⅝ in. gypsum plaster to both sides of the plank (except the cross wall between bedroom 1 and bedroom 2, which is 4½-in. brick, and the partition

between the w.c. and bathroom, which is of timber studding and which houses the water services and wastes).

31. The first floor is prefabricated in sections of grooved and tongued boarding, nailed to 2 in. by 1½ in. timber cross-joists, clipped on to the upper flanges of the steel floor joists.

32. The roof trusses are provided with clip-fixings for short-span purlins which are laid on a layer of roofing felt, subsequently nailed to the underside of the purlins. The eaves, fascia and soffit are of thin sheet metal with 4-in. half-round cast iron gutters and 3-in. cast iron down pipes.

33. The ceilings are plasterboard, fixed to the floor joists or trusses with a four-way pressed metal clip, and skim coated. The internal wall surfaces are two-coat plaster. The stud partition is surfaced with plasterboard, skim coated, with a removable panel for access to the services.

THE STEEL-CLAD HOUSE

34. Blocks 12 and 13 were built by the British Iron and Steel Federation. The houses are of a simple steel frame type, the frames and a considerable part of the other structural units and interior fittings being prefabricated.

35. In both blocks, a working kitchen plan with dining space was specially developed with the object, first, of simplifying the frame and the prefabricated units, and secondly of allowing a straight prefabricated staircase to be inserted. Vertical steel sheets, horizontal steel sheets, brick, and rendering were used for cladding. The windows and surrounds, in both blocks, as well as the eaves and verges of the roofs, are of steel. The flues are brick, and party walls are built of clinker blocks.

BLOCK 12

36. The surface concrete is a 4-in. concrete slab laid on hardcore.

37. The frame is of hot rolled structural steel, in light sections, and designed for rapid erection. The posts are spaced generally at 3 ft. 6 in. centres to take standard windows and surrounds. The frame has a centre spine of rolled steel joists carried on tubular posts supporting the first floor beams. The roof consists of steel trusses of rolled or tubular sections which support the steel ceiling joists.

38. The external cladding of the ground floor up to window head level is 4½-in. brick. The external cladding of the first floor is vertical ribbed steel sheet, backed by ½-in. fibreboard insulation. It is finished with a special rough texture "stone" paint. The flues are 9 in. by 9 in. of brick. The party wall is of cavity construction, each leaf being of clinker concrete blocks. The floor steel and spine at the party wall are discontinuous.

39. The inner leaf of both ground and first floors is of foamed slag concrete in one house and clinker concrete blocks in the other, leaving

a sufficient cavity for the steel frame to be accommodated. The partitions also are of foamed slag or clinker concrete blocks.

40. The roof is covered with protected metal sheets laid on an insulating layer of ½-in. fibreboard, and the eaves and verges are constructed of steel.

41. The ground floor finish consists of 2-in. fine concrete on a waterproof membrane, set directly on the concrete slab foundation. The surface in one house is linoleum and in the other substitute linoleum. The first floor is made up of rolled steel joists with ribbed expanded metal above and below. The finish is 4-mm. linoleum on 2 in. of concrete, poured *in situ*. The bathroom is tiled. The ceilings and internal wall surfaces throughout are two-coat plaster.

42. The staircase is a single prefabricated unit, of spot-welded pressed steel with wood treads. The windows are standard metal in light gauge pressed steel surrounds. The external doors and frames are standard steel casement sections. The side doors and frames are pressed steel; the internal doors are of timber in steel frames. The skirtings are of steel.

BLOCK 13

43. The frame is of light gauge sections, cold formed from mild steel strip and fabricated by spot and ridge welding. The posts are spaced generally at 3 ft. 6 in. centres to take standard windows and surrounds. The frame has a centre spine of light gauge beams carried on tubular posts supporting the first floor of light gauge channels. The roof consists of prefabricated trusses of light gauge sections, ridge welded at intersections.

44. The external cladding of the ground floor up to window head level is a coloured cement mortar rendering, partly on steel dovetailed sheeting and partly on paper-backed welded wire fabric. The external cladding of the first floor is of horizontal ribbed sheet steel. It is finished with a special rough texture " stone " paint.

45. The inner wall leaf of both floors is of prefabricated panels of plasterboard, resin-bonded to ½-in. fibreboard insulation, mounted on a stiffening of wood battens. In one house additional insulation was given by an aluminium foil membrane in the cavity of the external walls and by a glass wool blanket over the ceiling.

46. The first floor consists of twin light gauge channels, spot-welded together and spaced at approximately 2 ft. 0 in. centres. To these channels a batten and timber floor is attached by means of clips. The ceiling is of fibreboard or plasterboard, mounted on wood battens attached to the joists. The internal wall surfaces are plasterboard, skim coated with plaster. The party walls and partitions are finished in two-coat plaster.

47. The ground floor finish of both houses is coloured asphalt. The other features, the flues, the party walls, the roof covering, the staircase, the windows and doors are similar to those of Block 12.

B. POURED CONCRETE HOUSES

POURED CONCRETE CONSTRUCTION

48. To illustrate the use of some improved varieties of concrete recommended in the report *House Construction*, three blocks of houses (Blocks 1, 2 and 6) have been built of concrete poured *in situ*. The types of concrete chosen are those made with no-fines aggregate, which has especially good weather-resisting properties, and with lightweight aggregate concretes, whose thermal insulation value is of a high order. Two kinds of lightweight aggregate, foamed slag and expanded clay, were used.

49. It was a necessary part of the demonstration that the houses should be of similar design, so that all variables other than the method of construction might be excluded. The three pairs of houses, therefore, are built to the standard demonstration plan (Plan C) illustrated in Fig. 43, pp. 62–63, which was also used for the brick-built control house. Each of the pairs of concrete houses is a demonstration in the construction of walls and internal partitions; the floors, stairs, and roof are built of the same materials and by the same method as in the houses of brick.

50. Unskilled labour was mostly used for the building of walls and internal partitions. Poured concrete wall construction is known to be appropriate in places where skilled labour, especially bricklayers' labour, is temporarily in short supply. Such skilled labour as was used was required mainly for carpentry and for the erection of the formwork.

51. Poured concrete houses are not likely to prove economical unless they are designed for simple and efficient use of formwork. Standard unit shuttering was used for the demonstration houses, and the size of this shuttering largely determined the dimensions of the building parts. The photographs reproduced in the following pages show the extreme care that was taken to avoid extravagant shuttering.

52. The fixings of the units are designed to facilitate assembly and removal. Door and window openings are so arranged that the wall would not be divided into a number of narrow piers, since this would have reduced the strength of the wall and added to the difficulties of pouring. Complicated projections or returns, bay windows, porches and other excrescences are also avoided. The gable ends involve no special problems, but the amount of labour involved is high in relation to their surface area. Local circumstances will usually determine whether gables of poured concrete or framed and clad gables are the more economical to build, or whether hipped roofs are to be preferred to either.

53. The shuttering used for the ground floor walls of the no-fines concrete house was built up of wooden posts between which flat steel shuttering was placed. The shuttering used for the first floor walls of this concrete house and for the whole of the other concrete houses was built up in sections in the form of open timber frames strongly braced and faced on one side with small-mesh expanded metal. The concrete

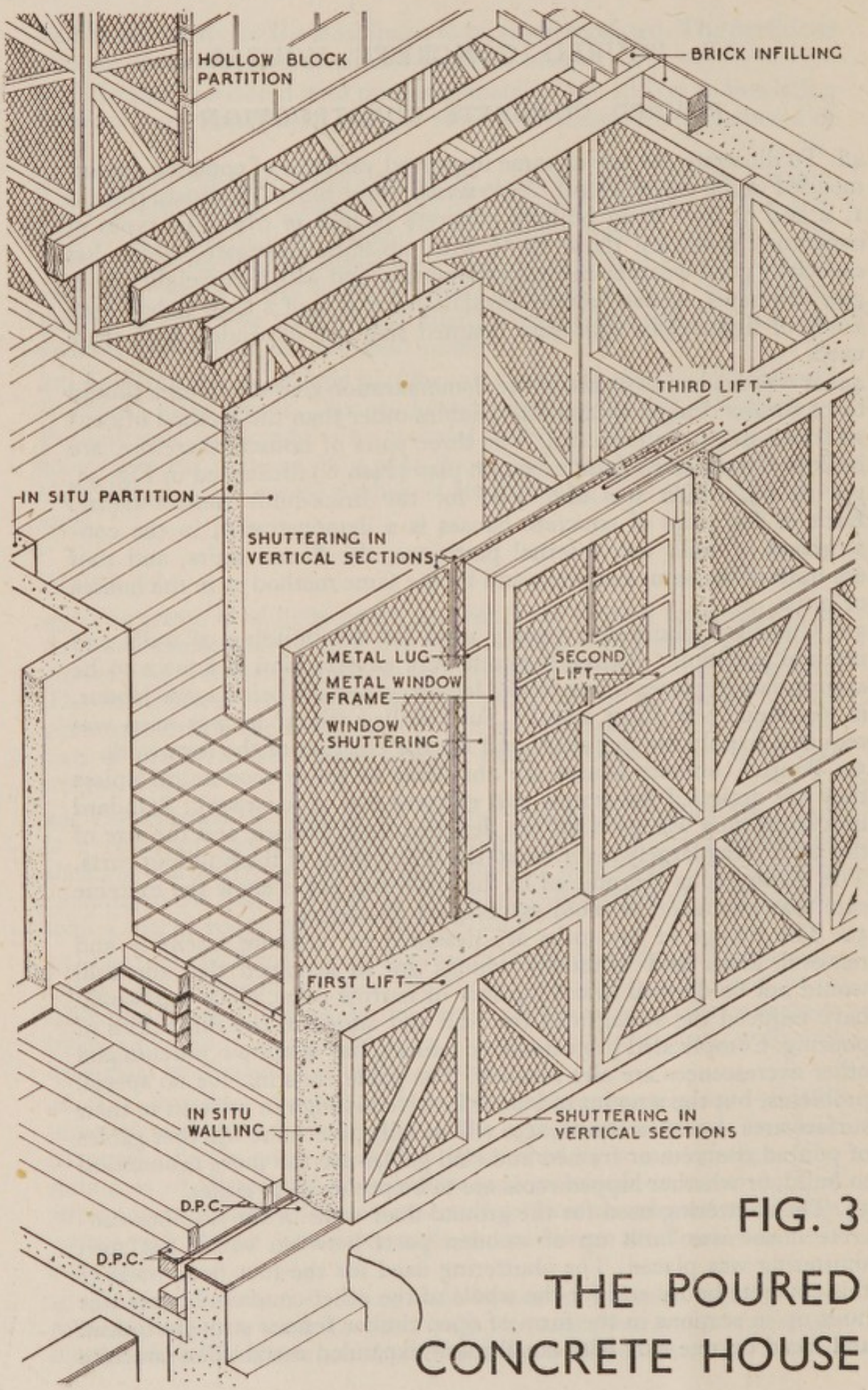


FIG. 3

THE POURED CONCRETE HOUSE

mix was of such a consistency that none of it seeped away through the meshes of the expanded metal, and the latter, when removed, left markings on the surface of the wall (less noticeable in the no-fines concrete house) which formed a key for the subsequent rendering.

54. No special virtues are claimed for these or any other types of shuttering. Steel mesh shuttering was used for the demonstration houses as a substitute for timber, and is likely to prove useful during the years immediately after the war.

55. The mixers, hoists, scaffolding, and other site equipment used for the demonstration houses were of the pattern usual for small-scale operations. But it is clear that on large building schemes poured concrete would come into its own as a rapid and economical method of building if proper attention were given to site equipment and site organisation.

56. Full tests were made of all aggregates, and sample walls were erected before the building work was started. The water content of the mixes is of importance, and special pains were taken to gauge it accurately. Generally, the minimum amount of water was used consistent with the length of runs and ease of pouring. No more punning or rodding was done than was necessary to ensure the filling of the forms.

57. Shrinkage is a problem, especially when lightweight aggregates are used. Since it is a function of the cement content it can usually be minimised by using mixes as lean as strength considerations will allow. But generally the stresses in the concrete set up by the shrinkage are relieved by the formation of fine cracks round the individual particles of the aggregate, and these do not provide a continuous path to the inner face of the wall for the passage of driving rain.

THE NO-FINES CONCRETE HOUSE

58. No-fines concrete, as its name implies, is made of cement and coarse aggregate only, the fine aggregate, such as sand, which is normally present in dense concrete, being omitted. Owing to the open cellular structure thus obtained there is little or no capillary action, thus moisture penetrating the rendering is seldom transmitted through the wall. A number of aggregates are suitable, including lightweight aggregates such as clinker. The no-fines concrete house (Block 1) is built partly with clinker and partly with ordinary gravel ballast. Both aggregates should be readily available in most areas in Great Britain.

59. The surface and foundation concrete, and the walls up to the level of the damp-proof course, are of normal dense type. The spread and thicknesses are the same as for traditional brick construction. The foundations are of 1 : 3 : 6 mix, and the walls 1 : 2 : 4 mix. Cement to *B.S.*12 was used throughout. Above the level of the damp-proof course the no-fines walling is of two kinds.

60. The external walls are built of concrete having an aggregate of clinker to *B.S.* 834 of $\frac{3}{4}$-in. minimum size, so graded that not more than

5 per cent. by weight passed a ⅜-in. sieve. The proportions of the mix are 1 : 6. The load-bearing walls are 12 in. thick and all other walls 8 in. thick. They are reinforced horizontally to their full length with three ⅜-in. mild steel rods placed 2 in. above door head height. The rods were cement washed before being placed and were bedded in 1 : 3 mortar. The U-value* of the 12-in. clinker aggregate walls has been calculated at U=0.23, which compares favourably with a U-value of 0.30 for the normal 11-in. brick cavity wall.

61. In the internal walls the aggregate is natural ballast to *B.S.* 382, of ¾ in. maximum size, so graded that not more than 5 per cent. by weight passed a ⅜-in. sieve ; the mix is 1 : 8. The party walls are 8 in. thick, and the load-bearing partitions 4 in. thick. All walls are reinforced horizontally with two ⅜-in. rods to *B.S.* 785, placed 2 in. above door head height. The rods were cement washed before placing, and bedded in 1 : 3 mortar.

62. The flues are of 9-in. internal diameter fireclay piping, 1 in. thick, jointed in fireclay mortar, and cast in position with a minimum cover of 5 in. of ballast concrete of the same mix as the internal walls.

63. The first floor joists are bedded in the walls to a depth of 4 in., the walls being levelled to take them with a 1-in. layer of cement mortar of 1 : 3 mix. The ends of joists are coated with bitumen and wrapped in felt.

64. The steel windows, complete with lugs, were fixed in position to the shuttering before the concrete was poured, and were thus cast in. Foamed slag concrete bricks for fixing joinery and skirting are cast in where practicable.

THE FOAMED SLAG CONCRETE HOUSE

65. Foamed slag is produced from blast-furnace slag, which is a by-product of the iron and steel industry. The slag is expanded or foamed by the steam which is generated when the hot slag is brought into contact with water. Foamed slag makes an excellent concrete, fully strong enough for house construction, and in particular it provides a high thermal insulation. It can be cut with a saw, and nails and screws can be driven into it without the use of plugs. At the request of the Government, the iron and steel industries are making plans for the large-scale production of foamed slag after the war at competitive prices. An annual output of over half a million tons is being aimed at. About 25 tons are needed for a house. Foamed slag may be assumed to be available at reasonable prices within a radius of say 50 miles of almost all ironworks, unless the blast-furnace slag is in insufficent quantity, or is required for other important uses, such as road construction.

66. Block 2 is built of concrete made with foamed slag aggregate. The external walls and the party wall are 8 in. thick. The U-value of these

* "U" represents the number of British Thermal Units transmitted through one square foot of the wall, floor or roof in one hour when there is a difference of temperature of 1° F. between the air on the two sides of the construction.

walls is calculated at U=0.16. The load-bearing partitions are of 4-in. thick concrete. The following mix is used :

112 lb. Portland cement to *B.S.* 12;

1 cu. ft. sand to *B.S.* 882;

8 cu. ft. of foamed slag aggregate to *B.S.* 877, of which 50 per cent. was from $\frac{1}{2}$ in. to $\frac{1}{8}$ in. and 50 per cent. from $\frac{1}{8}$ in. to dust.

67. The reinforcement, the flues, the bearing of the first floor joists, the external rendering and the other details of construction are similar to the no-fines concrete house.

THE EXPANDED CLAY CONCRETE HOUSE

68. Expanded clay is made by firing a suitable clay or shale to partial fusion. The properties and advantages of concrete made with expanded clay are very similar to those of other lightweight concretes, but, if skilfully mixed with the appropriate water content, the strength developed is greater. The material has been extensively used, with satisfactory results, in the United States. Production in Great Britain is at present in the experimental stage. It is not probable that expanded clay will be able to compete in price with bricks.

69. Expanded clay concrete is used for the walls of the two houses in Block 6. The external walls and party wall are 8 in. thick, and the load-bearing partitions 4 in. thick. The U-value of the 8-in. external walls is calculated at U=0·16—0·20.

70. The reinforcement, the flues, the bearing of the first floor joists, the external rendering, and the other details of construction follow the methods used in the no-fines concrete house.

C. THE BRICK-BUILT CONTROL HOUSE

71. A house of normal brick construction (Block 3) has been built as a control or yardstick to serve as a comparison with the poured concrete houses (Blocks 1, 2 and 6) and with the steel-frame brick-clad house (Block 10). In order to assist in this object of comparison the normal brick house and these other houses are all built to the same plan and general dimensions.

72. The foundation of the normal brick house (Block 3) is composed of the usual materials. Portland cement is ordinary or rapid hardening to *B.S.* 12, and aggregates, natural sand, gravel or washed stone to *B.S.* 882. The mix of the foundation concrete and the site concrete is 1 : 3 : 6 with a 2-in. maximum aggregate. The mix of the paving concrete is 1 : 2 : 4 with a $\frac{3}{4}$-in. maximum aggregate.

73. The external and party walls are 11-in. brick cavity construction, built in cement-lime mortar of 1 : 1 : 6 mix, with wall ties 4 ft. 0 in. apart horizontally at 2 ft. 0 in. vertically, staggered. The cement is Portland to *B.S.* 12. The lime is of medium hydraulicity to *B.S.* 890. The sand is clean, sharp, coarse grit, to *B.S.* 882. The brick, below ground, is a local common brick, and above ground facing brick and grooved machine-made brick ; all to *B.S.* 657. The damp-proof

course is slate to *B.S.* 743. Openings in the external walls are provided with 4-lb. lead flashings over heads. The internal load-bearing partitions are of 4½-in. brick.

NOTE ON THERMAL INSULATION

74. For convenience, the heat transmittance coefficient for the external walls of the houses described in Section II are summarised below. The figures have been computed and should be regarded as approximate :

The "Northolt" concrete-clad house (Block 7). Insulated with 1-in. glass wool and ½-in. fibreboard. U = 0·16

The brick-clad house (Block 10). Cavity wall; inner leaf of 2-in. clinker blocks, outer leaf 4½-in. brick. U = 0·28

The steel-clad house (Block 12).

Ground floor: Cavity wall; outer leaf 4½-in. brick, inner leaf 2-in. foamed slag. U = 0·27

As above, with inner leaf of 2-in. clinker concrete blocks. U = 0·29

First floor: Cavity wall; outer leaf steel sheet backed by ½-in. fibreboard, inner leaf 2-in. foamed slag. U = 0·22

As above, with inner leaf of 2-in. clinker concrete blocks. U = 0·24

The steel-clad house (Block 13).

Ground floor: Cavity wall; outer leaf of 1-in. cement mortar rendering, inner leaf ½-in. plasterboard with ½-in. fibreboard insulation. U = 0·26

As above, plus aluminium foil membrane in the cavity. U = 0·16

First floor: Cavity wall; outer leaf sheet steel, inner leaf ½-in. plasterboard with ½-in. fibreboard insulation. U = 0·26

As above, plus aluminium foil membrane in the cavity. U = 0·16

The no-fines concrete house (Block 1). 12-in. walls with clinker aggregate. U = 0·23

The foamed slag house (Block 2). 8-in. walls. U = 0·16

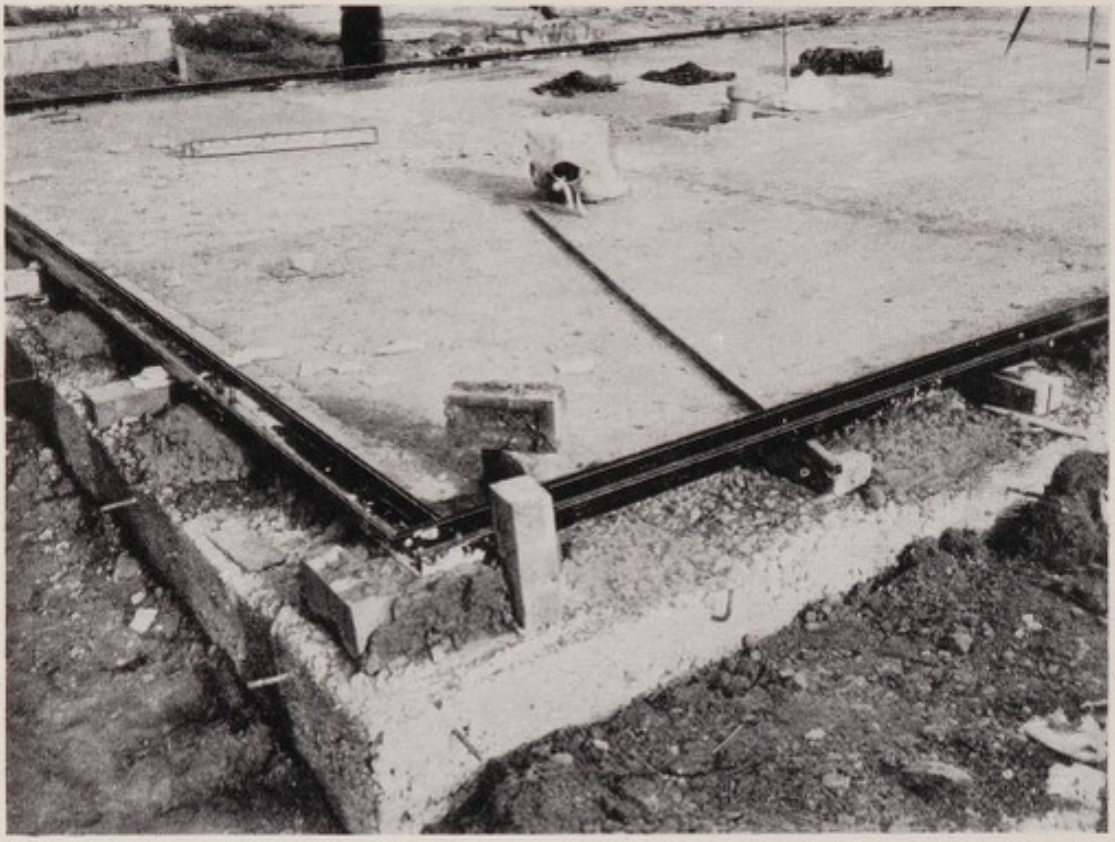
The expanded clay house (Block 6). 8-in. walls. U = 0·16–0·20

The standard brick control house (Block 3). 11-in. brick cavity walls. U = 0·30

STEEL FRAME HOUSES UNDER CONSTRUCTION

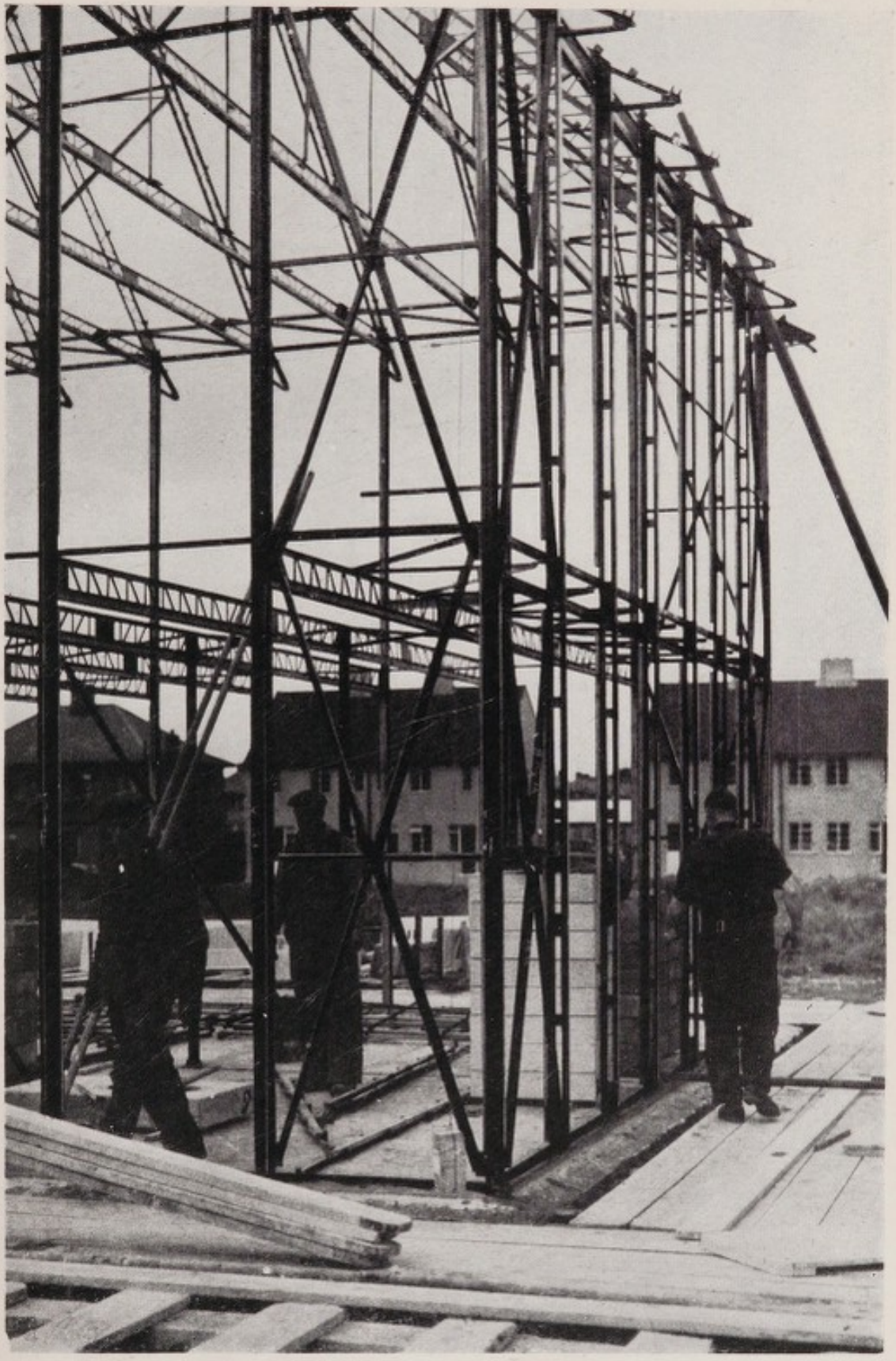
1. THE CONCRETE CLAD HOUSE

The steel frame is laid out on the concrete site slab, ready for erection. Long posts are for the outside, short ones for the central spine, lattice beams for the first floors. (*Fig.* 4.)

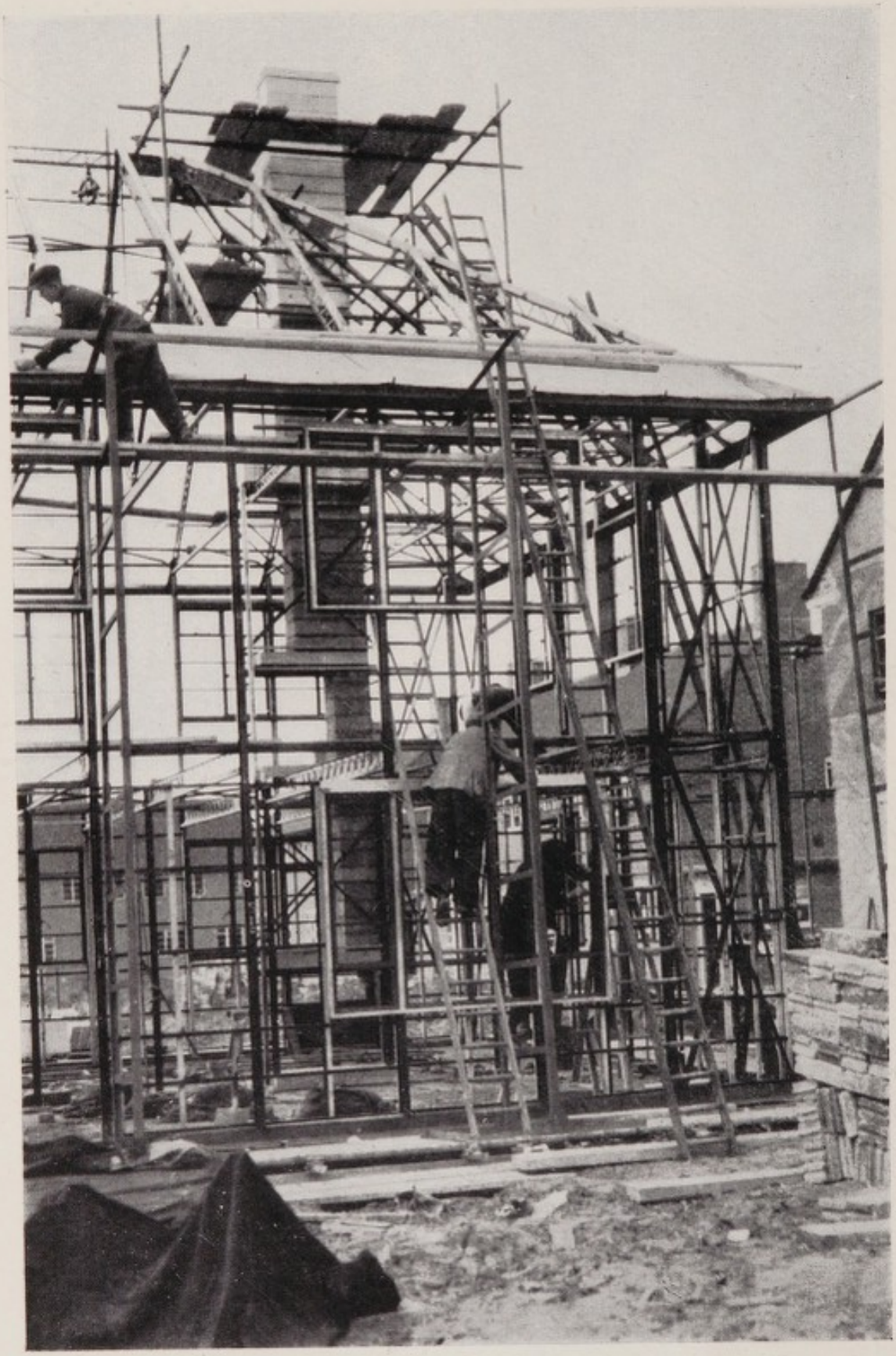


The upturned channel which is to receive the bases of the external wall posts has been carefully levelled and bolted down. (*Fig.* 5.)

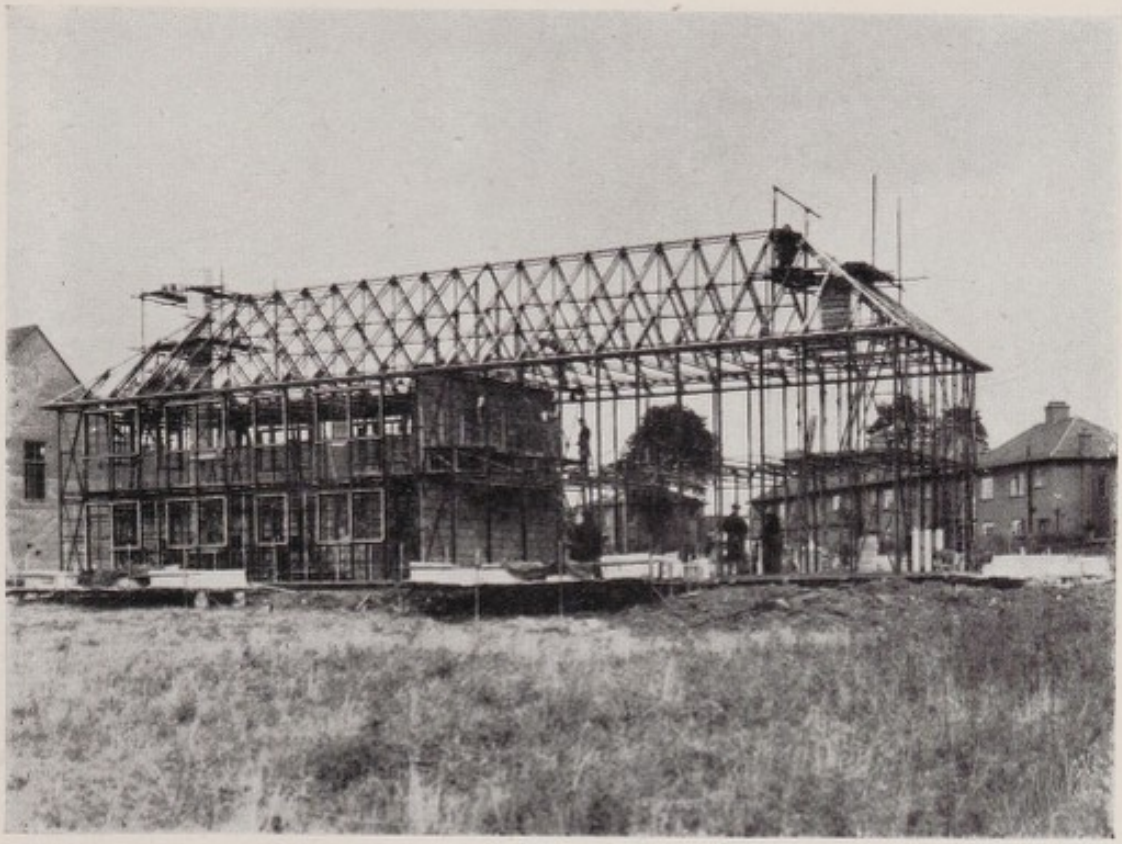
After half a day's work on the steel frame, the men on the left are completing the party wall framing. Stiffening braces are used on each side of the party wall. (*Fig.* 6.)



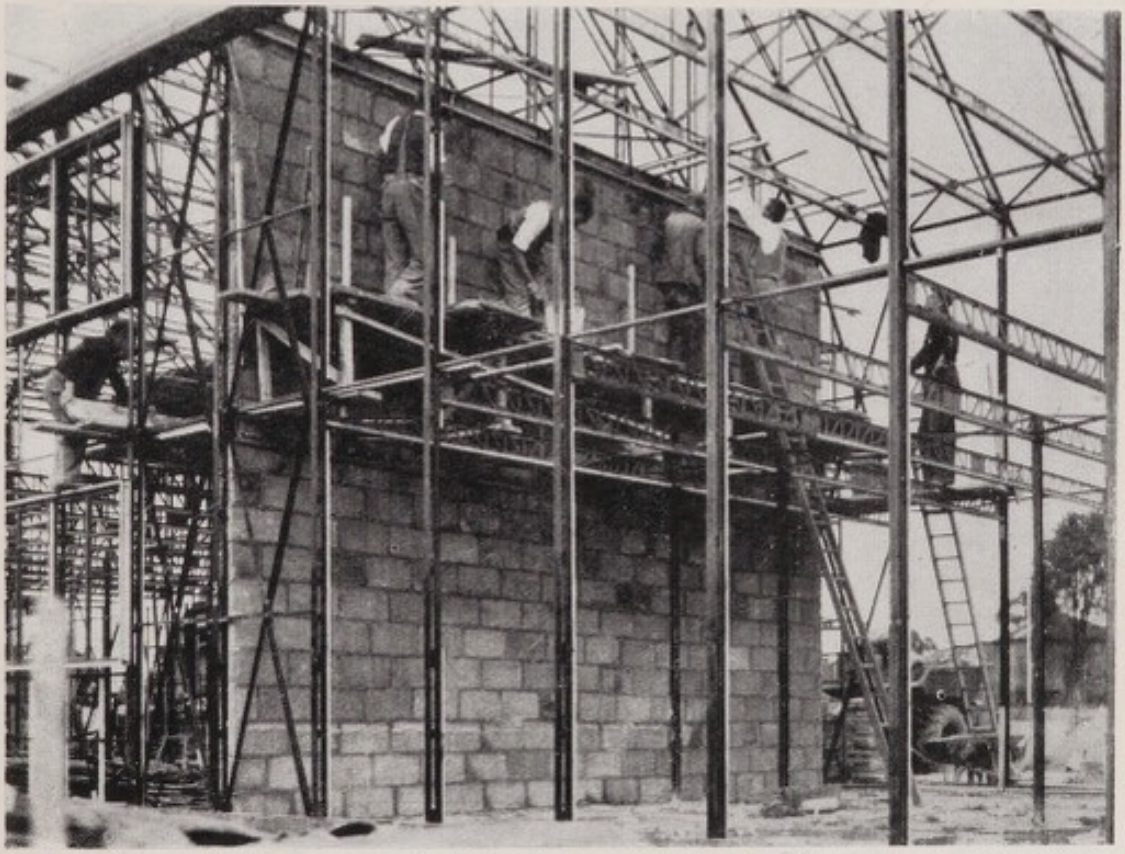
At the corners are more braces. The first floor lattice beams are in position. Concrete flue blocks lined with aluminous cement are stacked ready. (*Fig.* 7.)



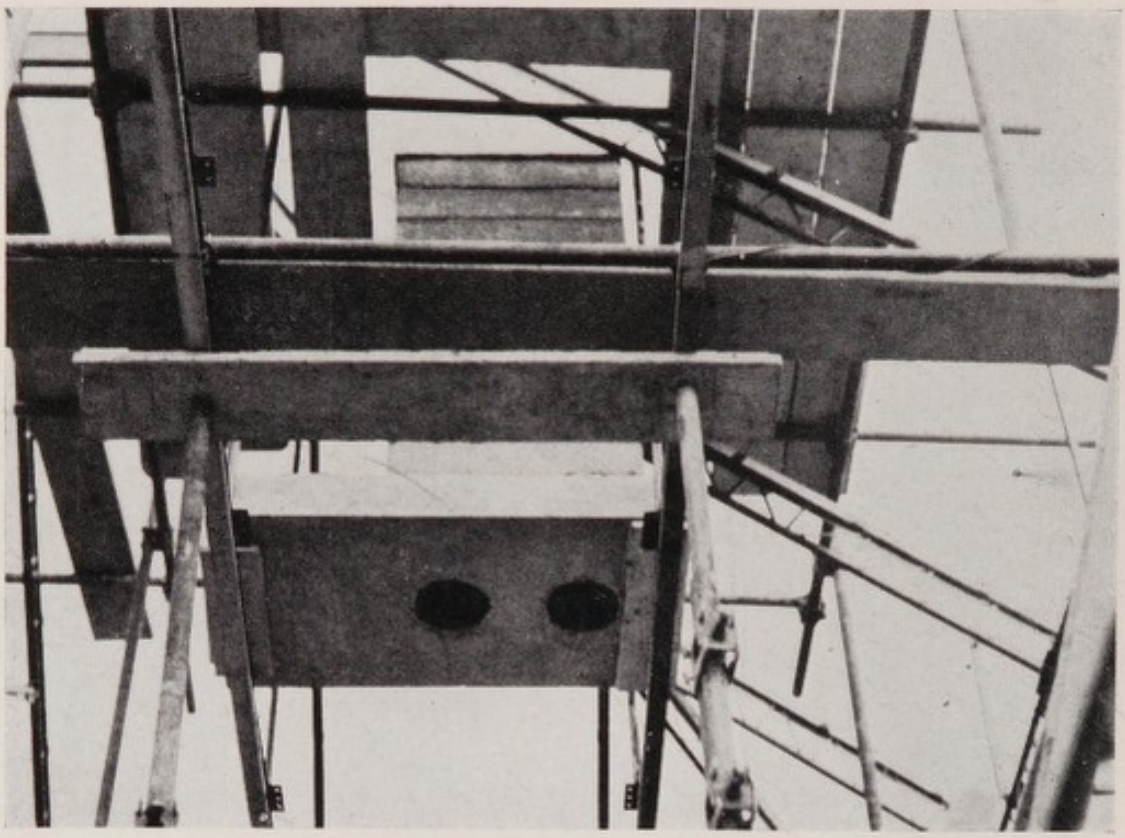
The flue stack is built. The exposed parts are in faced blocks. And now the windows are being fixed and felt is being laid on the roof. (*Fig.* 8.)



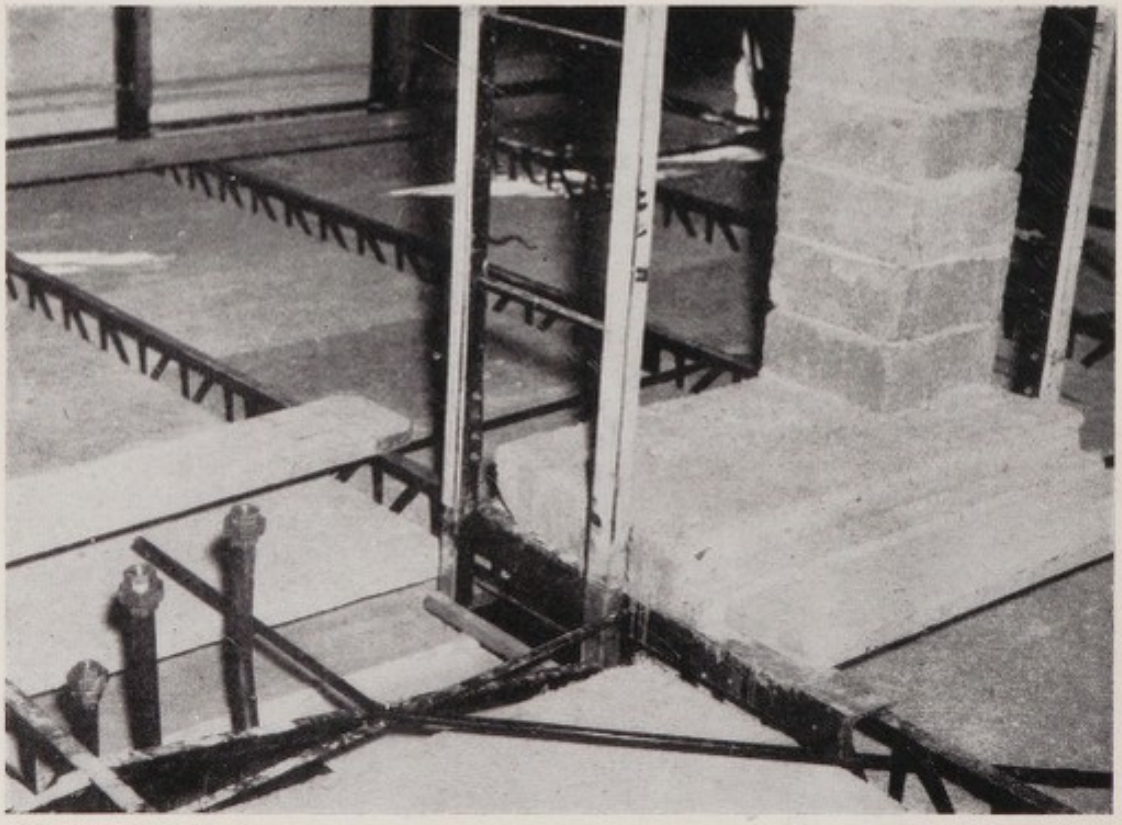
The fifth day: the frame is complete. The external facing slabs are arriving. (*Fig.* 9.)



The party wall has reached the first floor ceiling level. No scaffolding is used: the builders work on a staging set up on the first floor beams. (*Fig.* 10.)

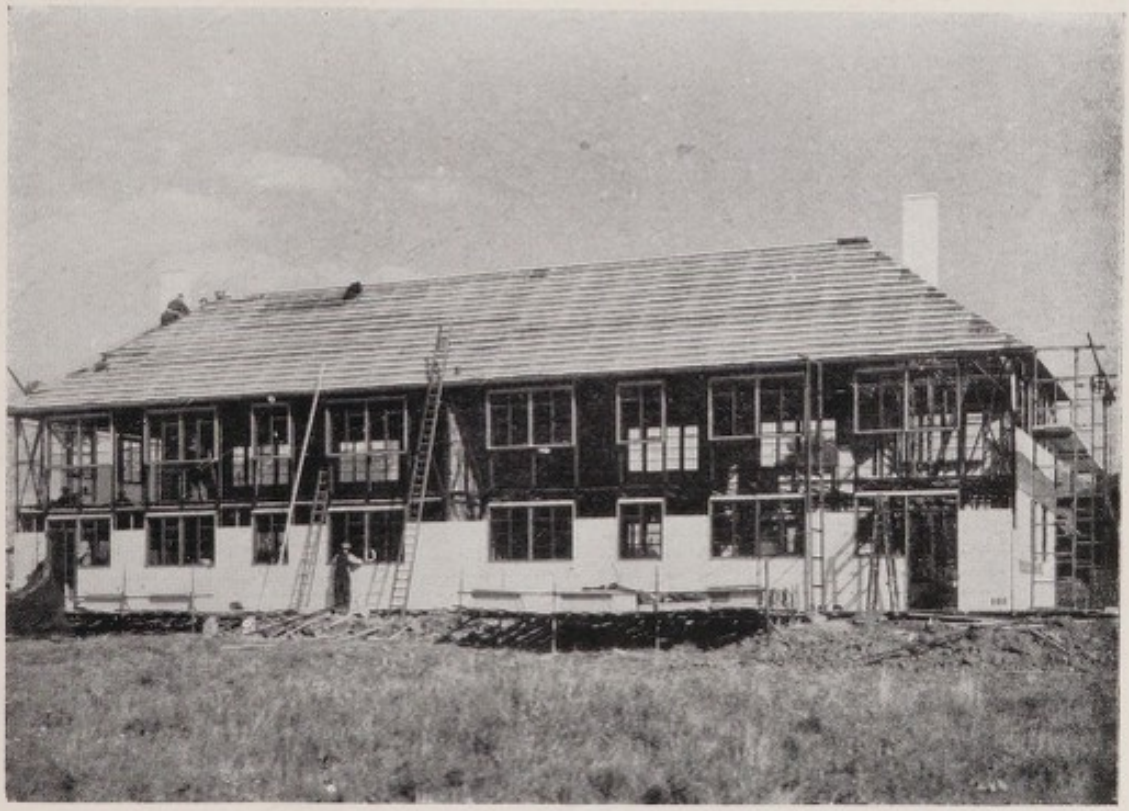


The upper part of the precast flue stack is built first. It is carried on a reinforced concrete slab laid between the ceiling beams. (*Fig.* 11.)



To stop airborne sound passing from one flat to the other, wood wool mats are hung between the floor beams. On the light steel legs lies a slab which carries the flue. (*Fig.* 12.)

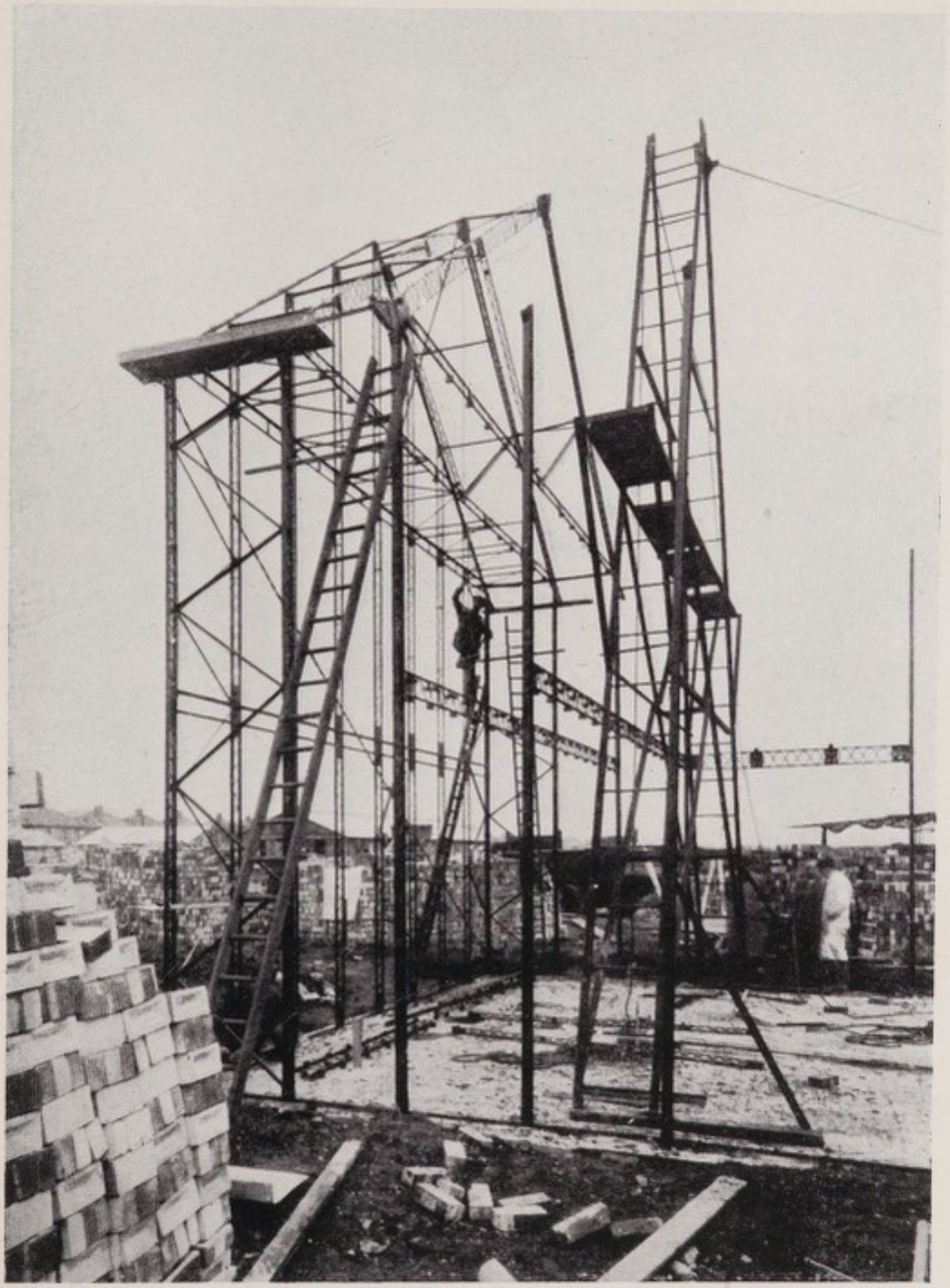
The external wall slabs are 3 ft. 4 ins. long, 1 ft. 4 ins. wide. They are made of pressed vibrated concrete, 2 ins. thick, into which a coloured rendering has been cast. (*Fig.* 13.)



The sixth day. The roof battening is completed. About half of the wall slabs are fixed. (*Fig.* 14.)

Below the wood wool mats (see Fig. 12) prefabricated ceiling slabs of plasterboard are slid into position. The slabs are 4 ft. long. (Fig. 15.)

A clean, dry house has been built in eight days. A few more days for finishing, and it will be ready for occupation. (Fig. 16.)



Afternoon on the first day. A gable frame has been set up. The steel eaves and fascia come with the framing. The high working ladder has been moved up for the work on the next bay. (*Fig.* 17.)

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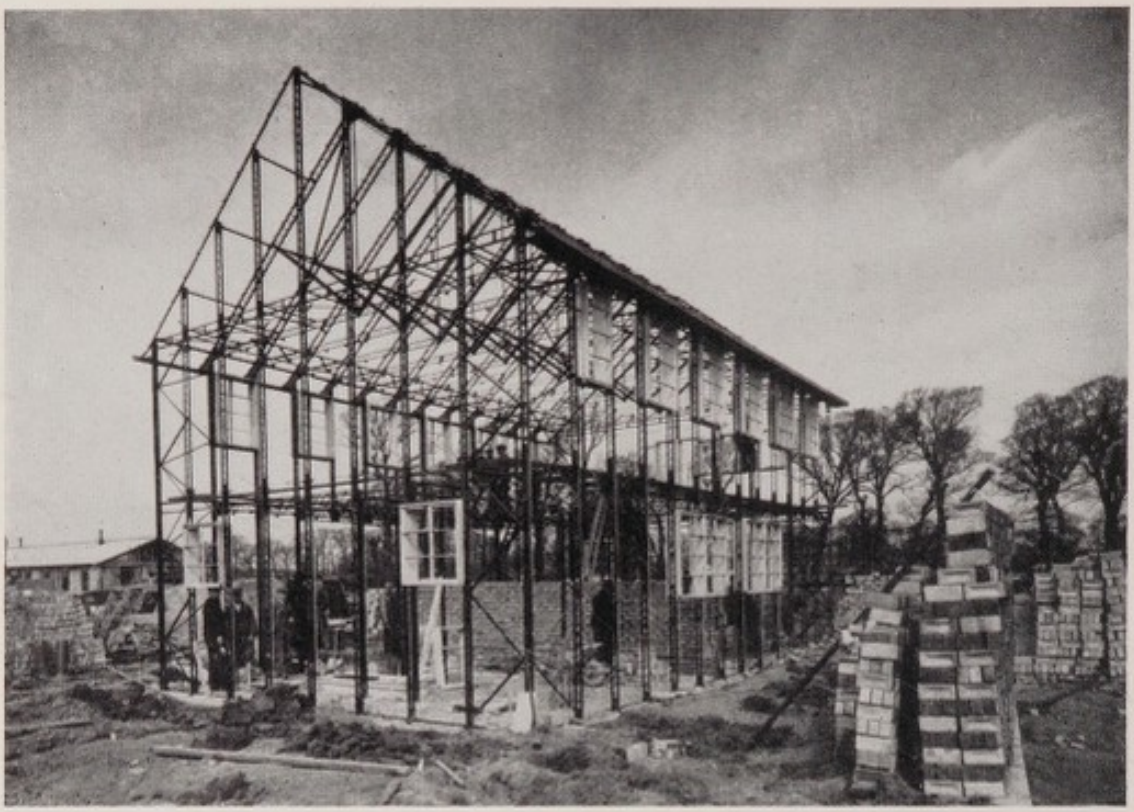
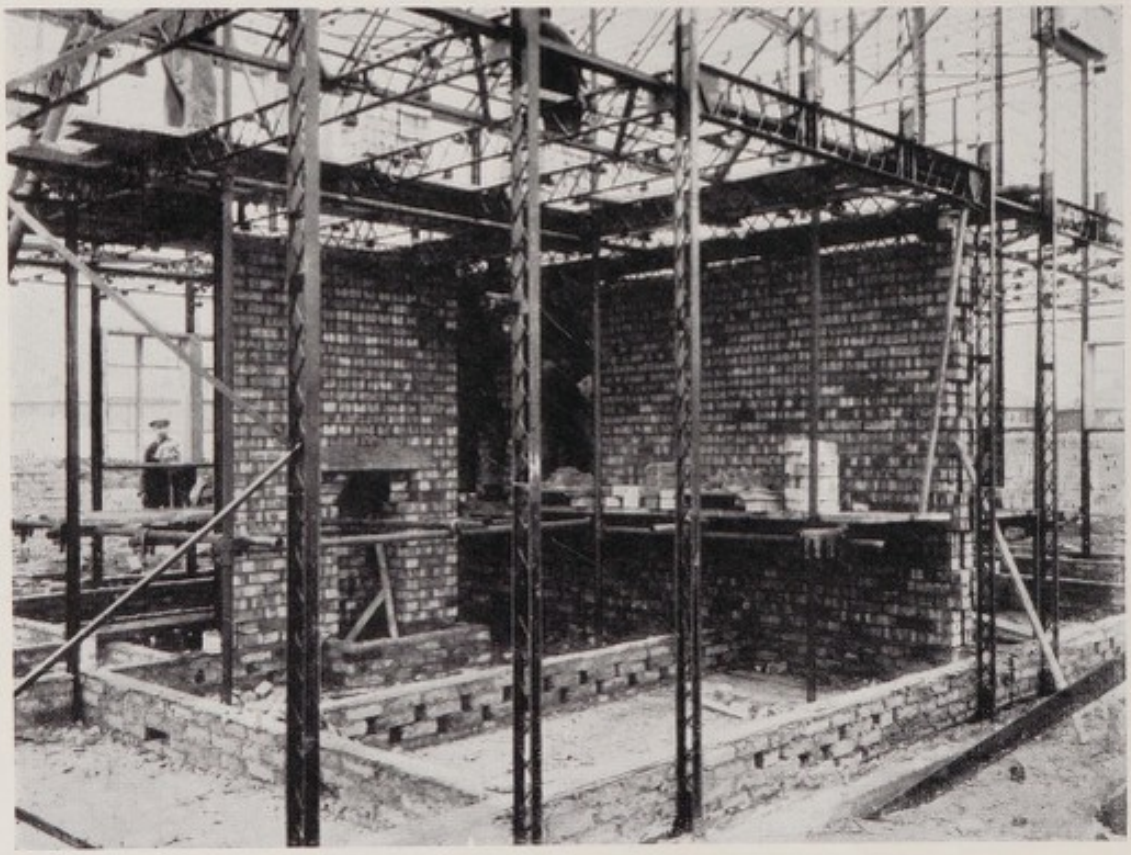
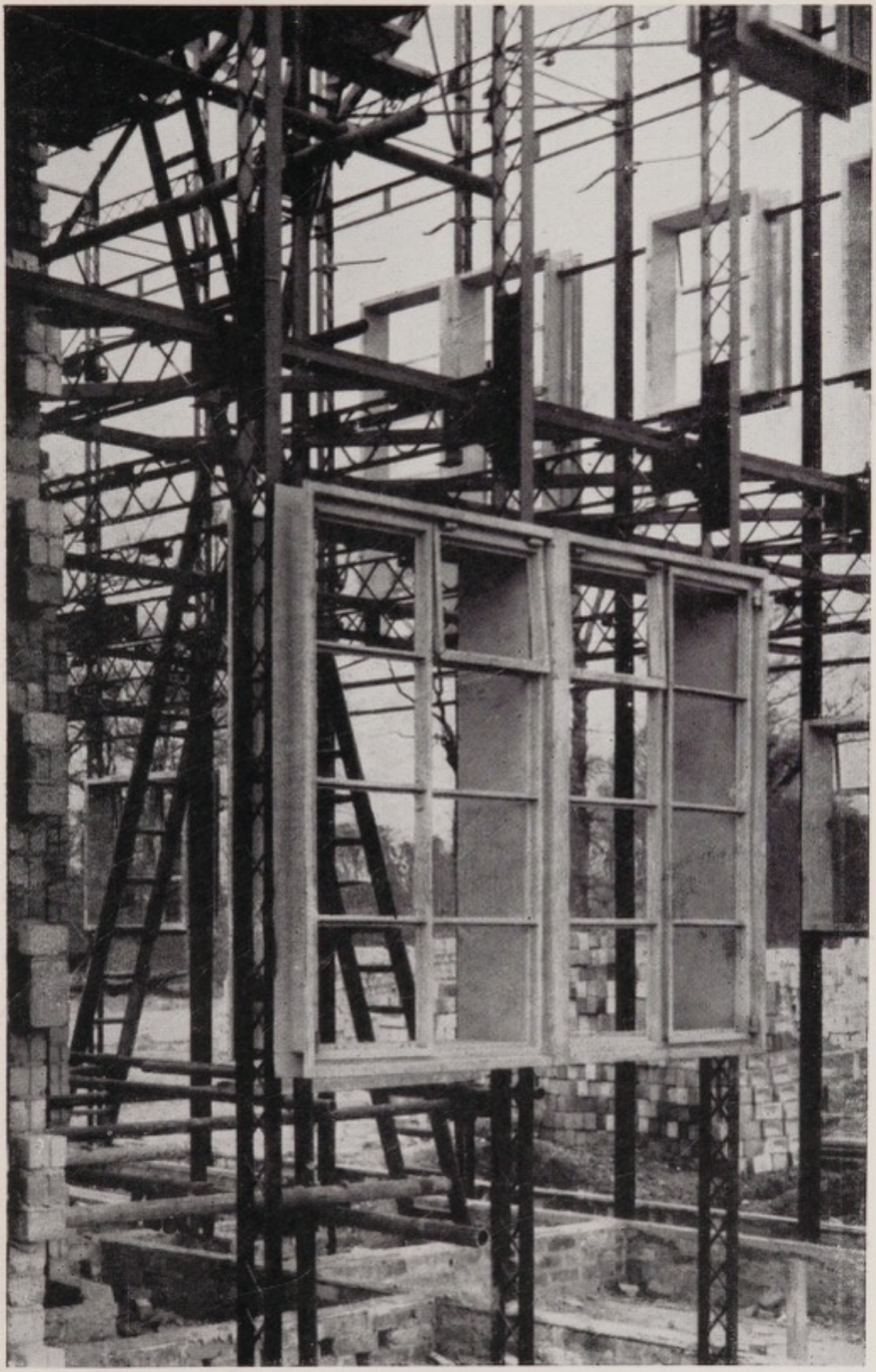


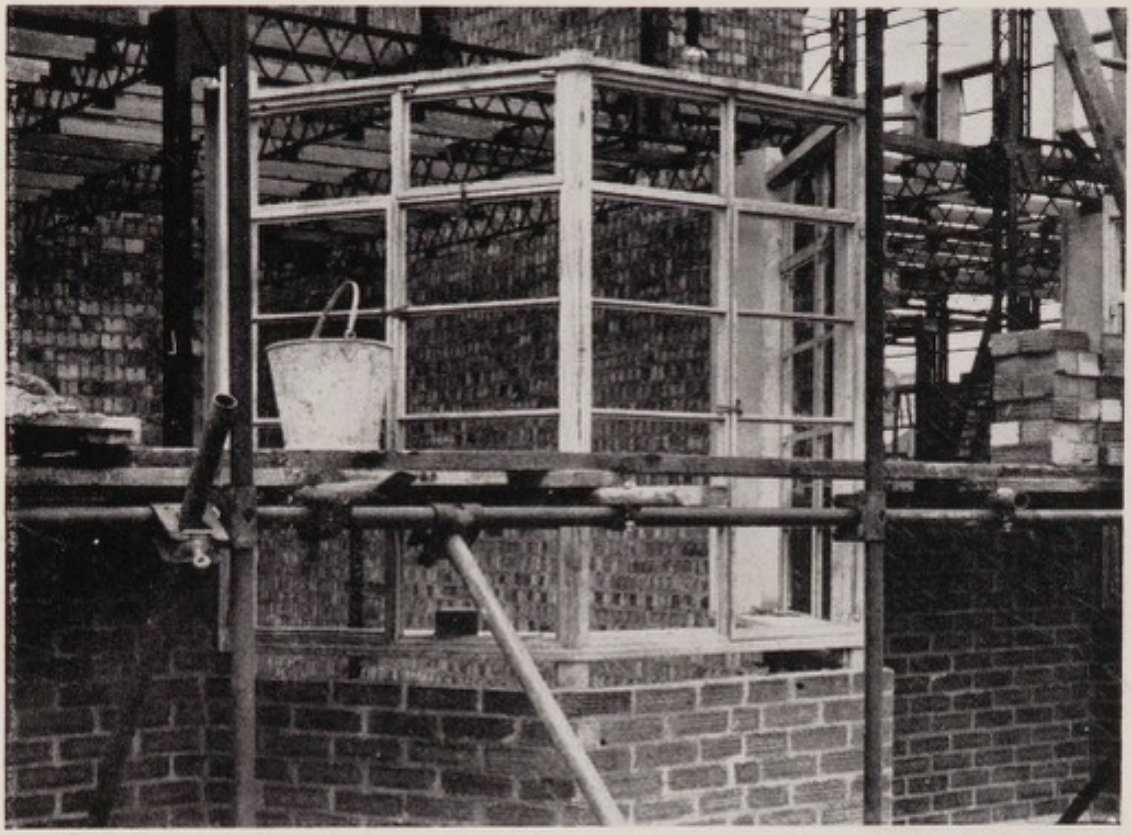
A week later the frame is completed. Windows are in position and the roof is ready for felting and battening, so that work may go on under cover. (*Fig.* 18.)



In this house, built-up lattice members are used for both posts and beams. A start has been made with the party wall and the chimney. (*Fig.* 19.)



The steel windows with their deep sheet steel linings were designed to fit exactly between the posts of the main frame. (*Fig.* 20.)



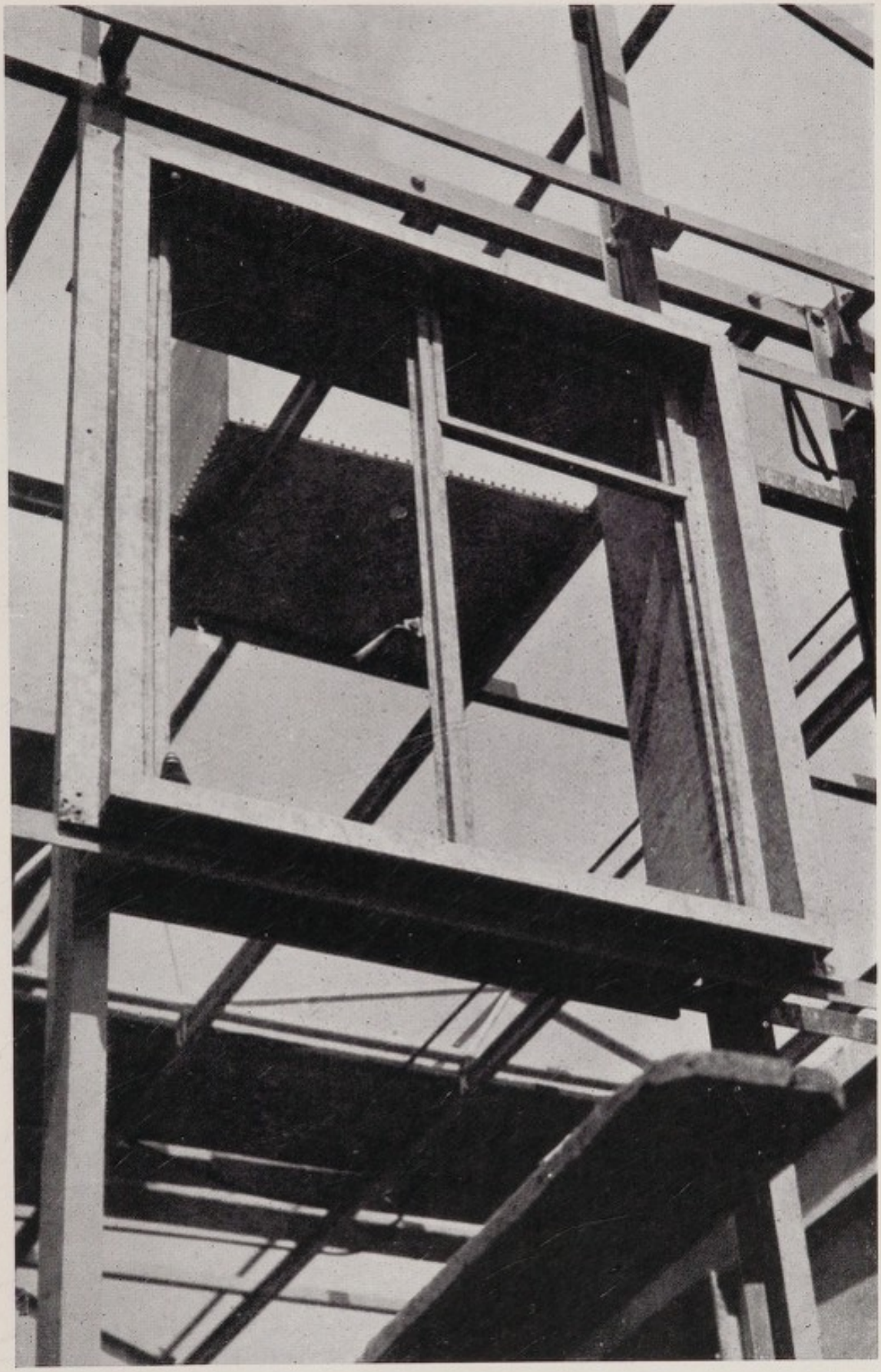
The bay windows were similarly designed. Each bay window is bridged by a short lattice beam which carries the first floor posts. The light first floor timber joists are in position. (*Fig.* 21.)

Despite bad weather, the house is finished to time. It only remains to clear the site and lay out the paths and gardens. (*Fig.* 22.)

With this house, once the site concrete is down, the next job is to start the building of the brick flue stacks. (*Fig.* 23.)

Stacks and frame go up together. After four days, the posts are in position complete with corner braces. One of the gables has been erected. (*Fig.* 24.)

The frame is complete; work begins on the sheet steel cladding. The stacks, which had stopped at first floor level, are now carried up. (*Fig.* 25.)



Electrical conduits are run. The cold water storage cistern is set up. The steel window linings set into the structural frame are common to all the steel frame houses. (*Fig.* 26.)

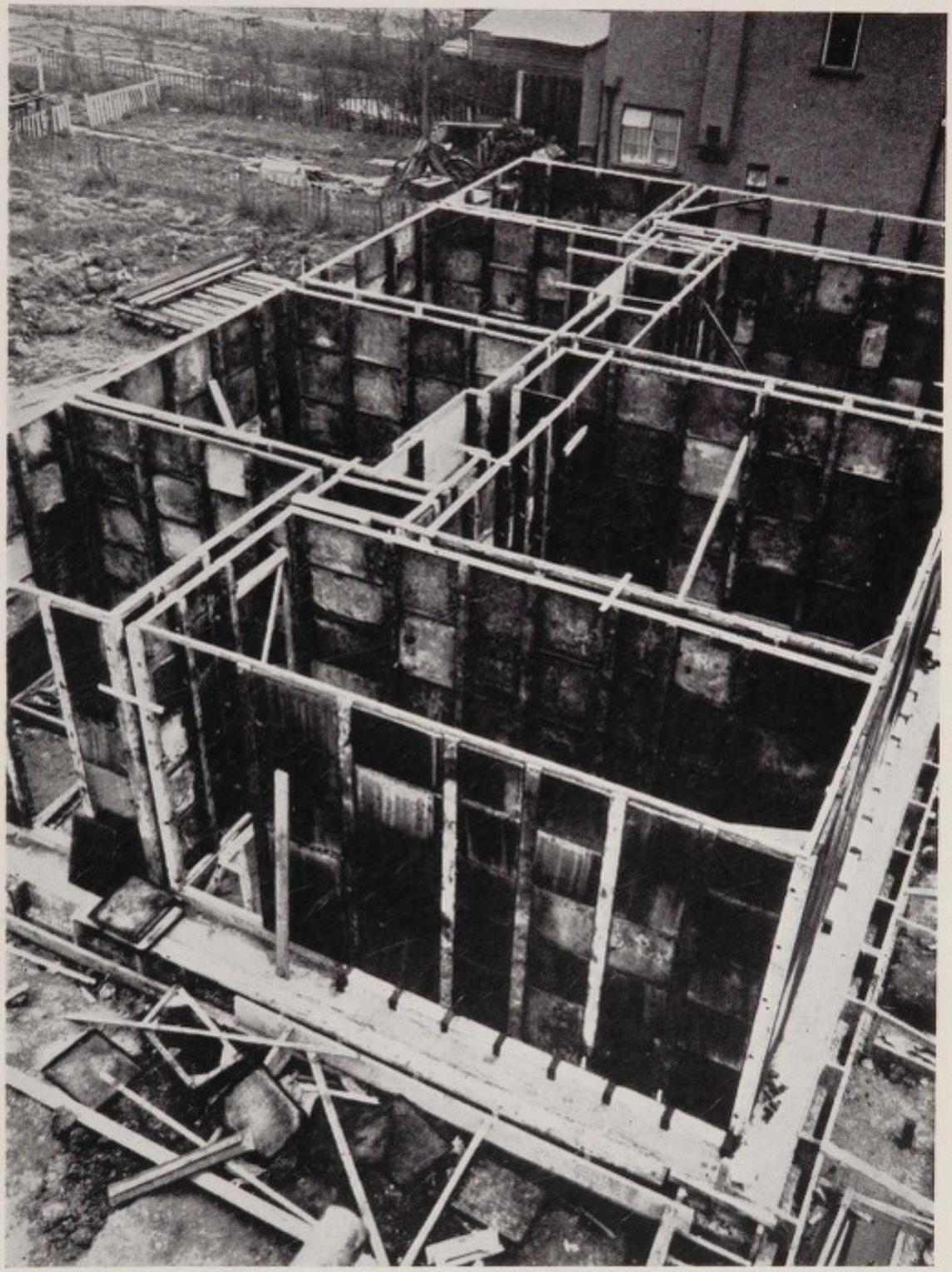
In Block 12, the vertical rib steel cladding to the first floor is completed. Eaves and fascia units are being fixed. The bricklayers are about to start on the ground floor cladding. (*Fig.* 27.)

The ground floor of Block 13 has steel cladding to back and front walls, dovetailed to hold the rendering. The rendering on the end walls goes on a wire mesh fabric backed with building paper. (*Fig.* 28.)

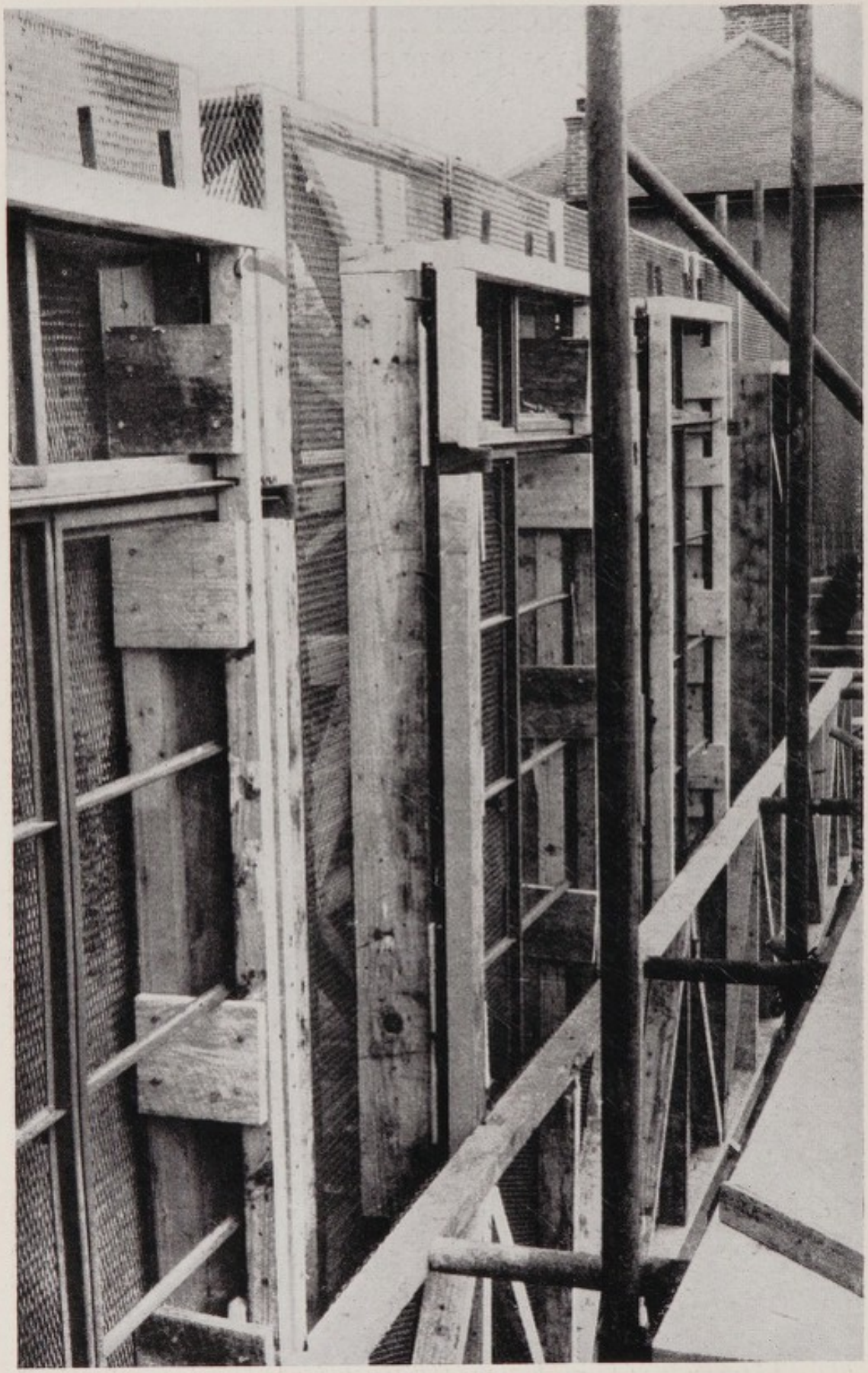
Meanwhile, Block 12 *has also been making good progress. The ground floor brick cladding is nearly up and the chimney cappings are being fixed. Both houses are nearly ready.* (*Fig.* 29.)

The first rough rendering coat is soon applied. The first floor cladding receives its rough texture "stone" paint. (*Fig.* 30.)

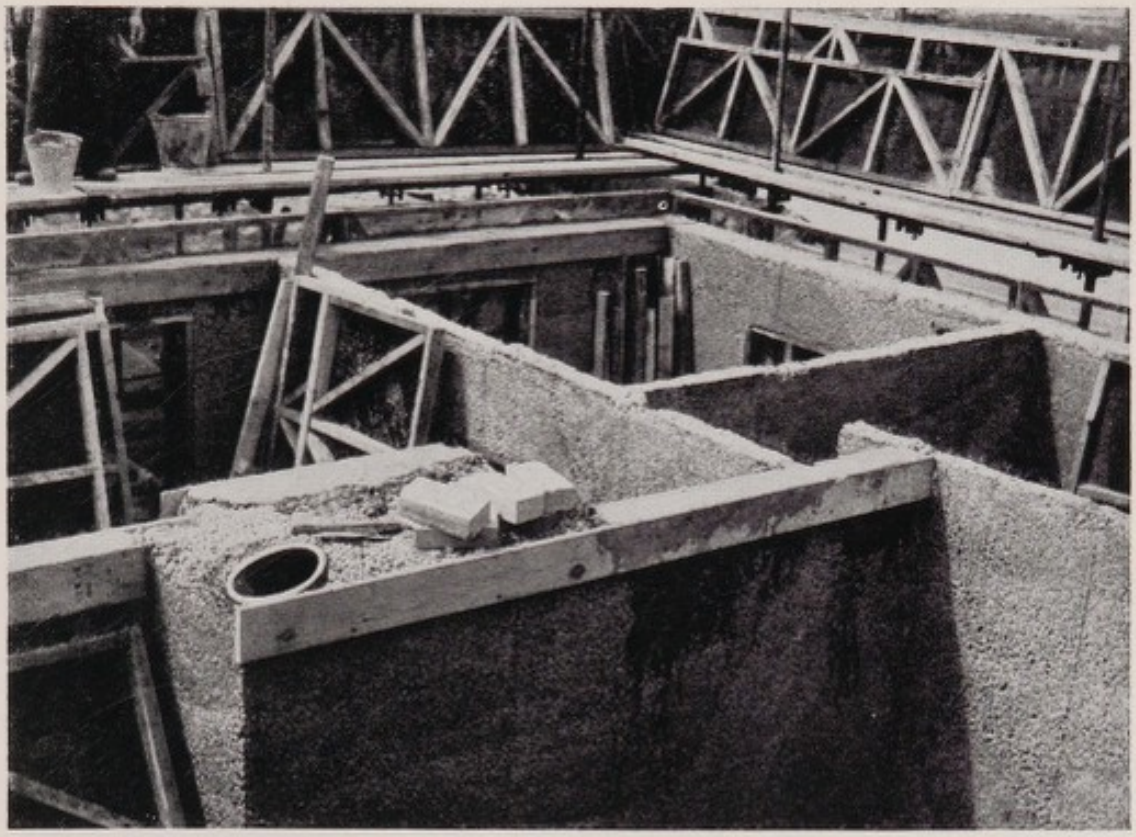
POURED CONCRETE HOUSES UNDER CONSTRUCTION



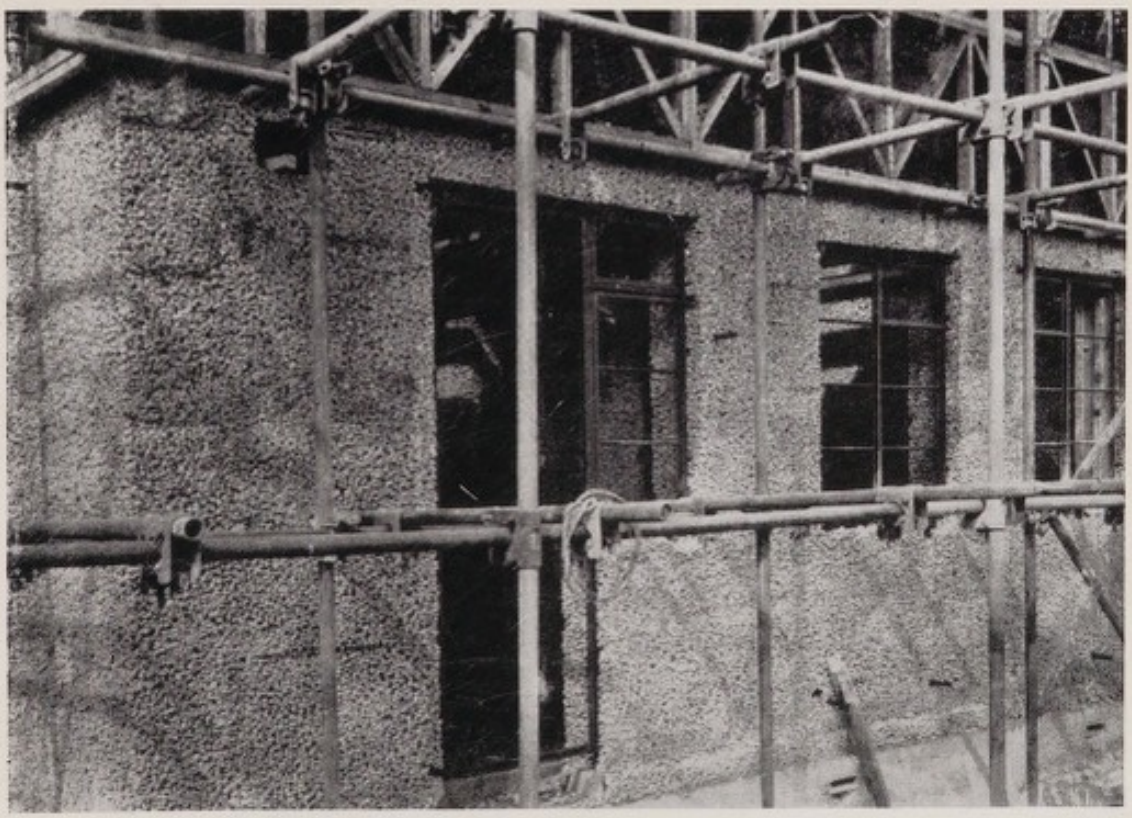
For the ground floor of the no-fines concrete house (Block 1) the shuttering is built up of flat sheet steel pans secured to wooden posts. (Fig. 31.)



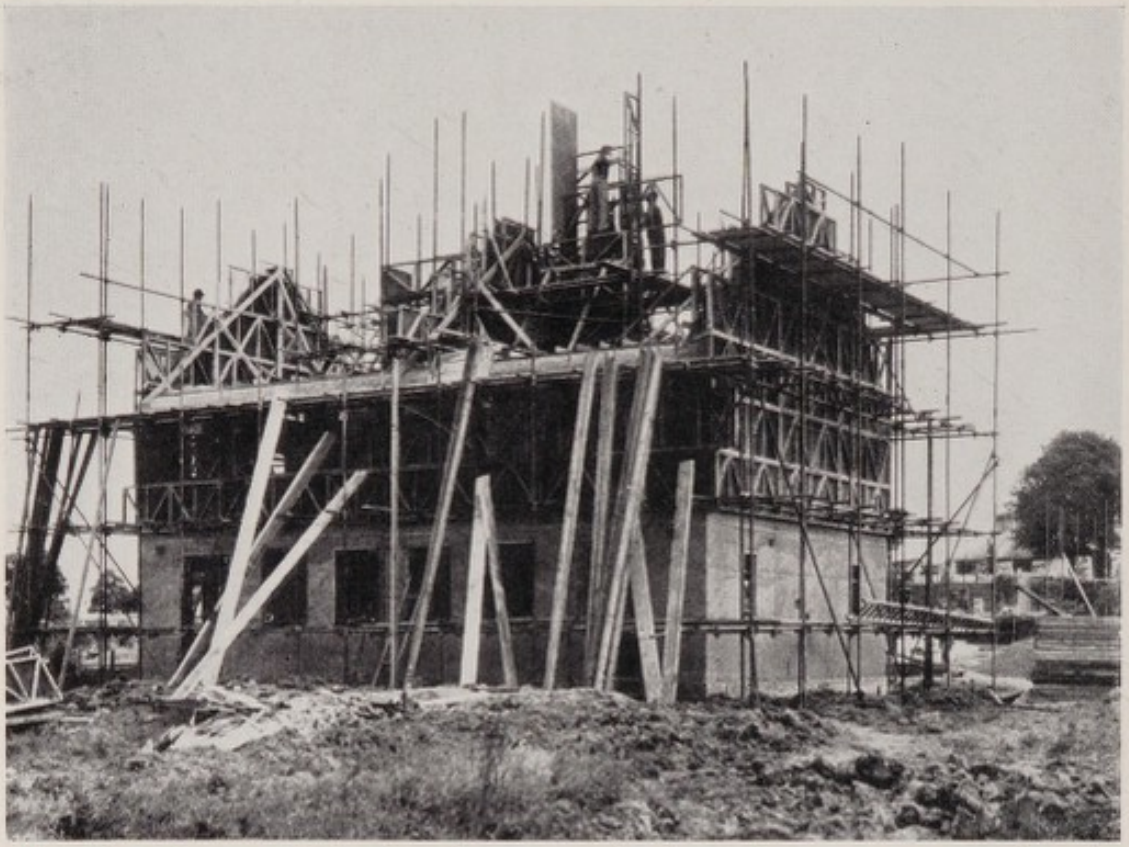
Elsewhere, shuttering is of expanded metal mesh on timber framing. So that the shuttering units may be withdrawn from the windows, a special "split box" design is used. (*Fig.* 32.)



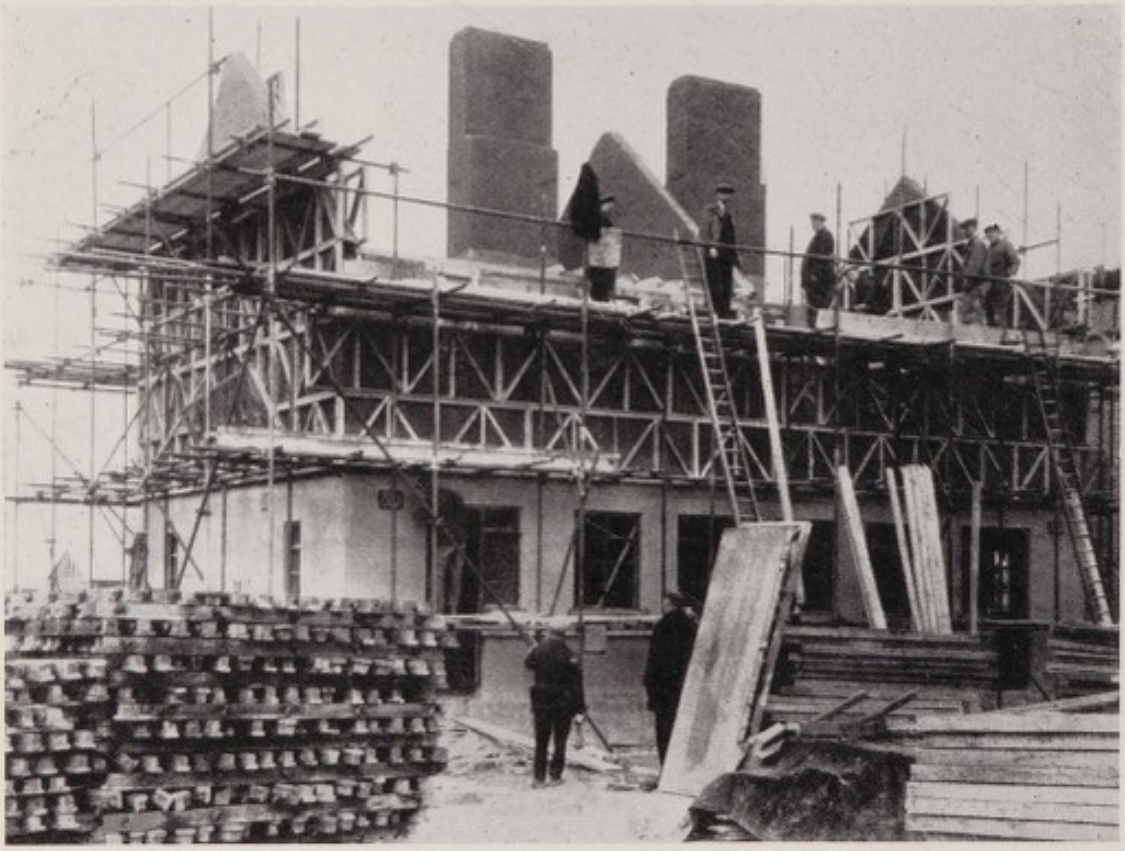
The shuttering from flue stack and internal walls comes down. The in situ poured flue has a cylindrical fireclay lining. (*Fig.* 33.)



These rough and pitted no-fines concrete walls provide an excellent key for rendering. Where foamed slag concrete is used, the impression of the expanded metal shuttering forms the key. (*Fig.* 34.)

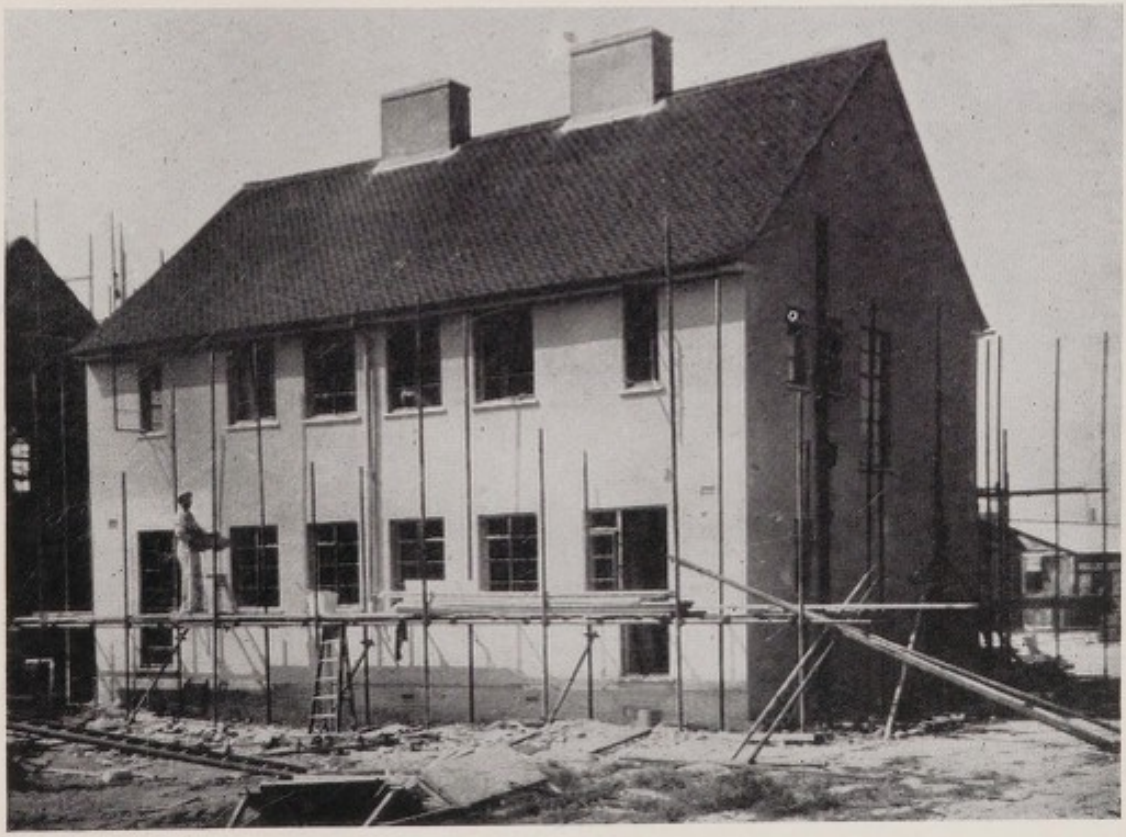


The first floor walls having been poured, shuttering now goes up for the three gables (one in the party wall) and the two flue stacks. (*Fig.* 35.)



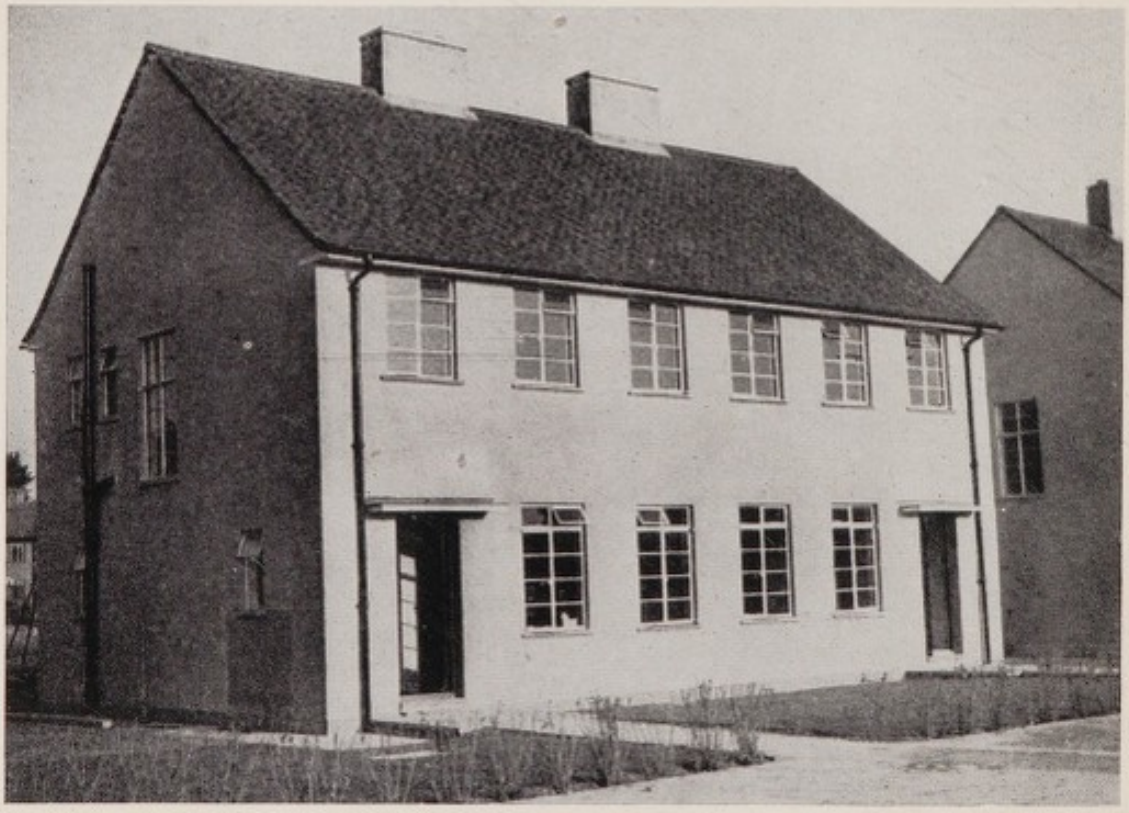
Fourteen days later this shuttering has done its work and can be struck. The first floor shuttering will be the last to come down. (*Fig.* 36.)

A rendering coat has been applied to the chimneys. The roof timbering is completed and work is starting on eaves aud fascia. (*Fig.* 37.)



A coloured roughcast finish is thrown on by means of a portable apparatus worked by turning a handle. (*Fig.* 38.)

A clear, even colour penetrates into the deeply textured wall. The plinth rendering is applied by hand in the usual way. (*Fig.* 39.)



A similar design was used for the three pairs of poured concrete houses (*Blocks* 1, 2 *and* 6). (*Fig.* 40.)

III. PLANNING

A. TYPICAL PLAN ARRANGEMENTS

THE THREE PLAN TYPES

75. In *Housing Manual* 1944 the Government accept the suggestion advanced in the report *Design of Dwellings* that houses and flats should be planned round a particular way of living in the house. Such planning is not possible without a proper understanding of the meaning of the word *kitchen*, about which a great deal of confusion still exists. The accepted definition is that a kitchen is a room in which meals are cooked. The same room may be used also as a living room, in which case it is described as a kitchen-living room; or it may be used also as a scullery and wash house, and so become a working kitchen; or it may be used as a dining room, when dining kitchen is the appropriate name. These three types of kitchen are the core of the house plan in each case and determine its general development.

76. Within this rough framework of three general plan types, each having its own characteristics, designers should be free to develop variations suitable to the peculiar needs of each locality. For example, families in which the workers are engaged in "clean" occupations will usually prefer an upstairs bathroom; for others a downstairs bathroom may be preferred. Wide and narrow frontages will allow of many alternative plans either one room or two rooms deep from front to back. Where larger houses can be built, additions in the form of sitting rooms for kitchen-living room houses or separate dining spaces for working kitchen houses will be appreciated.

77. Each house type, however, requires certain subsidiary accommodation without which it would be incomplete: the kitchen-living room house should always have a scullery and a wash house (separate or combined) and the dining kitchen house should have a wash house so that clothes washing may be kept out of the room used for family meals.

78. The whole of the houses described in this section are built of normal brick construction, with 11-in. external cavity walls. The specification generally is similar to that for the brick-built control house.

THE KITCHEN-LIVING ROOM HOUSE (PLAN A)

79. This is the house type most commonly adopted by local authorities before the war. It is a type that will prove popular in certain localities. If planned without a sitting room it offers less privacy and general amenity than any other type of house, and indeed in this rudimentary

5—21474

form the type is not likely to commend itself; if a sitting room is added the house requires a floor area of very nearly 900 sq. ft. for satisfactory planning.

80. The two plan arrangements illustrated in *Housing Manual* 1944 included one with a sitting room and one without; the total areas are 900 and 800 sq. ft. respectively. Where a house of an intermediate size is required, the kitchen-living room type will not generally be found to offer the most efficient solution.

81. Block 5 consists of a pair of kitchen-living room houses. The two plans (*see* Fig. 41, pp. 58–59) are alike and both are similar to the larger of the two plans illustrated in *Housing Manual* 1944. This house, with its separate scullery and wash house, its good outside store and its downstairs w.c., is especially suitable for country districts.

82. In the following tables (Tables III to VIII inclusive), the sizes of the rooms in the various house types as built at Northolt are compared with the standard range of sizes recommended in *Housing Manual* 1944.

TABLE III. THE KITCHEN-LIVING ROOM HOUSE (BLOCK 5)

FLOOR AREAS

In square feet (including built-in cupboards where provided)

ROOM	RECOMMENDED RANGE	BLOCK 5
Kitchen-living room	170–180	180
Sitting-room	110–120	112
Scullery	35–45	44
Wash house	35–45	49
Bedroom 1	135–150	145
Bedroom 2	110–120	110
Bedroom 3	70–80	70

THE WORKING KITCHEN HOUSE (PLAN B)

83. In the report *Design of Dwellings* it is suggested "that the municipal house of the future should provide two good rooms on the ground floor, so that meals need not interfere with other activities." This condition is fulfilled in the following house types:

a. The kitchen-living room house with sitting room.

b. The working kitchen house with separate dining space.

c. The dining kitchen house.

The condition is not fulfilled either in the kitchen-living room house without a sitting room, or in the working kitchen house without a separate dining space. For that reason, *Housing Manual* 1944 contains

only one illustration of the former type and only three of the latter as against seven of working kitchen houses with separate dining space. A single pair of demonstration houses without dining space has, however, been built to illustrate a type which will always appeal to people who prefer one large, airy room.

84. Block 9 consists of a pair of houses of medium size – *i.e.*, with a total floor area of 850 sq. ft. – and is similar to the working kitchen type plan arrangement of that size illustrated in *Housing Manual* 1944 (for plans, *see* Fig. 42, pp. 60–61). Despite the modest overall size of the house, the floor area of the living room is somewhat greater than the highest recommended figure. The wide frontage makes it possible for this room to have a large window at each end. Such a wide frontage plan is especially suitable for areas where the cost of land, roads and services is not a principal consideration. If built in pairs (as at Northolt), daylighting throughout the house reaches a very high standard, which would only be slightly reduced in the kitchen if the side windows were moved to allow of a continuous terrace layout (*see* Table IV).

Table IV. The Working Kitchen House (Block 9)

Floor Areas

In square feet (including built-in cupboards where provided)

ROOM	RECOMMENDED RANGE	BLOCK 9
Living room	180–200	210
Working kitchen	90–100	98
Bedroom 1	135–150	142
Bedroom 2	110–120	110
Bedroom 3	70–80	70

THE HOUSE WITH A SEPARATE DINING SPACE

85. Two of the plan arrangements for working kitchen houses illustrated in *Housing Manual* 1944 show a living room having an extension of less width than the main part of the room. This extension is, in effect, a dining space. A further development is to divide off the dining space so that it becomes independent of the living room and could be turned into a separate room simply by the insertion of doors.

86. This type of house may have a dining space continuous with the living room and separated from the working kitchen by a door; or the dining space may be continuous with the working kitchen and separated

from the living room. This last variety of plan gives a house approximating to the dining kitchen house, the principal difference being that a separate wash house, though it may be useful, is not as necessary as in the dining kitchen house. A third variety of plan within this same basic type is that in which the dining space is totally shut off and becomes a real dining room; one such plan is illustrated in *Housing Manual* 1944.

THE STANDARD DEMONSTRATION PLAN (PLAN C)

87. The working kitchen plan type with a separate dining space was adopted for the brick-built control house (Block 3), which provides the standard demonstration plan for comparing alternative methods of construction. The three pairs of concrete houses and the pair of brick-clad houses with a steel frame (Blocks 1, 2, 6 and 10) were built to this plan. (*See* Fig. 43, pp. 62–63.) These houses with their narrow frontage of 20 ft. offer an interesting comparison with the wide frontage house described above. The total floor area in each case is 850 sq. ft.; the plan is similar to the narrow frontage working kitchen house of 870 sq. ft. floor illustrated in *Housing Manual* 1944.

88. Although, as was explained in Section I, the heat installations and equipment in these houses are not to be regarded as representing the Government's advice to local authorities, attention should nevertheless be drawn to the position of the flue stack in the houses built to Plan C. In this plan, the open fires (or openable stoves) in the living room and in bedroom 1 are grouped with the independent hot water boiler round a flue stack in the centre of the house. The hot water storage cylinder and the heated airing cupboard are immediately next to this stack, so that the primary hot water circulation is extremely compact. Heat losses are therefore reduced to a minimum, while at the same time the principal rooms in the house are sufficiently near to receive some benefit from its warmth.

89. A further advantage in this plan is that the party wall is free from flues. This greatly simplifies its construction where, as here, the party wall is of the cavity type recommended for good insulation from next-door noises.

THE TERRACE HOUSE (PLAN D)

90. To afford experience of the building of houses in continuous terraces, a plan similar in accommodation to the standard demonstration plan was used for a block of four wide-fronted houses (Block 8). The total floor areas here also are 850 sq. ft.

91. The two middle houses in Block 8 (*see* Fig. 44) have a large first floor extending over the open passage below. In many cases advantage would be taken of the extra space available to provide additional bedroom accommodation in one of the two houses as suggested in *Housing Manual* 1944. In this demonstration block, however, the space is added to the normal three bedrooms.

TABLE V. THE WORKING KITCHEN HOUSE WITH SEPARATE DINING SPACE

FLOOR AREAS

In square feet (including built-in cupboards where provided)

ROOM	RECOMMENDED RANGE	BLOCKS 1, 2, 3, 6 AND 10	BLOCK 8
Living room plus dining space	225–245	247*	231
Working kitchen ..	90–100	78	79
Bedroom 1	135–150	140	153
Bedroom 2	110–120	114	110
Bedroom 3	70–80	70	85

THE DINING KITCHEN HOUSE (PLAN E)

92. The dining kitchen house with its separate wash house (in some cases combined with a scullery) is a type which is now receiving increasing attention. It admits of great flexibility in planning; but it differs from the kitchen-living room and working kitchen types in that if the wash house is to be included in the house (and not placed in an outbuilding) a total floor area of something over 850 sq. ft. is the least that will allow the various ground floor rooms to be planned to the correct size. Moreover, this type is seen at its best in wide-fronted houses. The popularity of the dining kitchen house will, therefore, be greatest where the cost of land, roads and services is not a principal consideration, and where building costs are such that larger size houses approaching 900 sq. ft. floor area can be built.

93. The houses in Block 4 follow very closely one of the plan arrangements illustrated in *Housing Manual* 1944. The total floor area is 900 sq. ft. (*see* Fig. 45, pp. 66–67). Of the two demonstration houses of this size, this is essentially a house for the town worker living in a suburb. The house as built faces north and the plan is suitable for north to east aspects. The wash house is separated from the dining kitchen by a small lobby, which ensures that the dining kitchen does not suffer from a multiplicity of doors.

THE DINING KITCHEN FLAT

94. The two-storey block of flats in the past has enjoyed considerable popularity in Scotland, where flats are more usual than in England. It is probably the fact that the upper flat in a two-storey block can easily be given an independent external front door that has made this type of block peculiarly attractive. Just before the war the type was receiving

* Blocks 3 and 10 have bay windows which add 12 sq. ft. to the figure given in this Table.

sufficient attention in England to make a Government demonstration appropriate and timely.

95. The method of construction chosen for this block of flats (Block 7) has already been described in paragraphs 17–26. The plans of the flats are illustrated in Fig. 46. The ground floor flat is a normal three-bedroom dwelling designed for a household of five; the first floor flat is a four-bedroom flat designed for a household of six. Both flats are of the dining kitchen type. Provision for clothes washing is necessarily in the dining kitchen. (*See* Table VI.)

TABLE VI. THE DINING KITCHEN DWELLING (BLOCKS 4 AND 7)

FLOOR AREAS

In square feet (including built-in cupboards where provided)

ROOM	RECOMMENDED RANGE	BLOCK 4	BLOCK 7	
			GROUND FLOOR FLAT	FIRST FLOOR FLAT
Living room	160–180	161	180	180
Dining kitchen	110–125	126	128	128
Wash house	35– 45	38	—	—
Bedroom 1	135–150	114	145	148
Bedroom 2	110–120	116	117	117
Bedroom 3	70– 80	74	73	73
Bedroom 4	70– 80	—	—	73

B. EMERGENCY HOUSING

THE SUB-DIVIDED HOUSE

96. One method of providing emergency housing immediately after the end of the war is temporarily to use a standard-sized dwelling for two families designed so that it can be simply and economically enlarged into a full-size dwelling when the period of emergency is over. Of the various alternative designs that have been developed, that adopted for the Ministry of Works demonstration involves the smallest amount of labour and material for conversion into a full standard home. One of the two tenants may remain in occupation, without discomfort or inconvenience, while the conversion is being carried out. The planning of the block follows the recommendations of a sub-committee of the Central Housing Advisory Committee of the Ministry of Health presided over by Mr. Lewis Silkin, M.P.

97. The emergency dwelling (Block 11) consists of a three-bedroom house of 900 sq. ft. total floor area, so planned that it may be temporarily used by two smaller families, each of which is accommodated in a self-contained flat. Each flat has its own external front door, and the two

front doors are not contiguous. When the house is no longer required for emergency use, a few simple alterations are made to internal partitions. Redundant equipment is removed and should in most cases be good for re-use in another house or flat.

98. Each of the emergency flats contained within the hull of the 900 sq. ft. house is of the kitchen-living room type. The main drawback of this dwelling is that the kitchen-living room is very small in size and if any clothes washing is done it must be done in this room, since a scullery or wash house cannot be provided within the main building. The ground floor flat, designed for two persons, has a bedroom 15 sq. ft. larger than the upper limit in the official range of room sizes and would therefore be more than sufficient to be used either as a bed sitting room or to accommodate a small child. The first floor flat, designed for three persons, has full standard double and single bedrooms. Table VII below gives the areas of the rooms.

FLATS INTO HOUSES

99. Block 11 has been designed to include one house sub-divided for emergency purposes and another converted for permanent use. This converted house is of the dining kitchen type, and is suitable for a household of five. The large bedroom of the lower flat becomes the living room; the living room of the flat becomes the dining kitchen; and the bathroom becomes the combined scullery-wash house. The living room of the upper flat becomes the principal bedroom, and the bedroom of the flat remains as a second double bedroom of No. 1 bedroom size. There is a w.c. on the ground floor and another in the bathroom, which is on the first floor. (*See* Table VII.)

TABLE VII. THE SUB-DIVIDED HOUSE (BLOCK 11)

FLOOR AREAS

In square feet (including built-in cupboards where provided)

ROOM	RECOMMENDED RANGE FOR PERMANENT HOUSING	EMERGENCY DWELLINGS (KITCHEN-LIVING ROOM TYPE)		HOUSE AFTER CONVERSION (DINING KITCHEN TYPE)
		GROUND FLOOR FLAT	FIRST FLOOR FLAT	
Kitchen-living room	180–200	143	144	—
Living room	160–180	—	—	165
Dining kitchen	110–125	—	—	145
Scullery-wash house	65– 80	—	—	66
Bedroom 1	135–150	165	139	144
Bedroom 2	110–120	—	—	138
Bedroom 3	70– 80	—	70	70

COMPARATIVE ROOM SIZES

100. It may be of interest to compare the sub-divided house erected by the Ministry of Works with a similar house built at Dalmuir by the Town Council of Clydebank. Mr. S. Bunton, A.R.I.B.A., was the architect. Plans and particulars of this house were included in the Report of the Scottish Housing Advisory Committee recently published under the title *Planning Our New Homes*.*

101. The Scottish sub-divided house (known as the Duplex house) has a total floor area of 1,140 sq. ft., 240 sq. ft. more than the English house. The emergency flats are of the working kitchen type; clothes washing would be done in the working kitchen, as is good normal practice, instead of having to be brought into the kitchen-living room as in the English sub-divided house. Each flat is designed for four persons and contains two double bedrooms of reduced size. The house when converted for permanent use becomes a working kitchen type house, large enough for six persons, with a large dining space, and containing three double bedrooms, of which the first is very substantially larger than the accepted English standard. The work required for conversion is more than that for the English sub-divided house.

102. The following Table, giving the room sizes of the English and Scottish sub-divided houses, together with those of the factory-made emergency bungalow built by the Ministry of Works, affords a convenient comparison between the most important proposals for emergency housing that have so far been advanced.

* *Planning Our New Homes*. H.M. Stationery Office. 3s. net (by post 3s. 5d.).

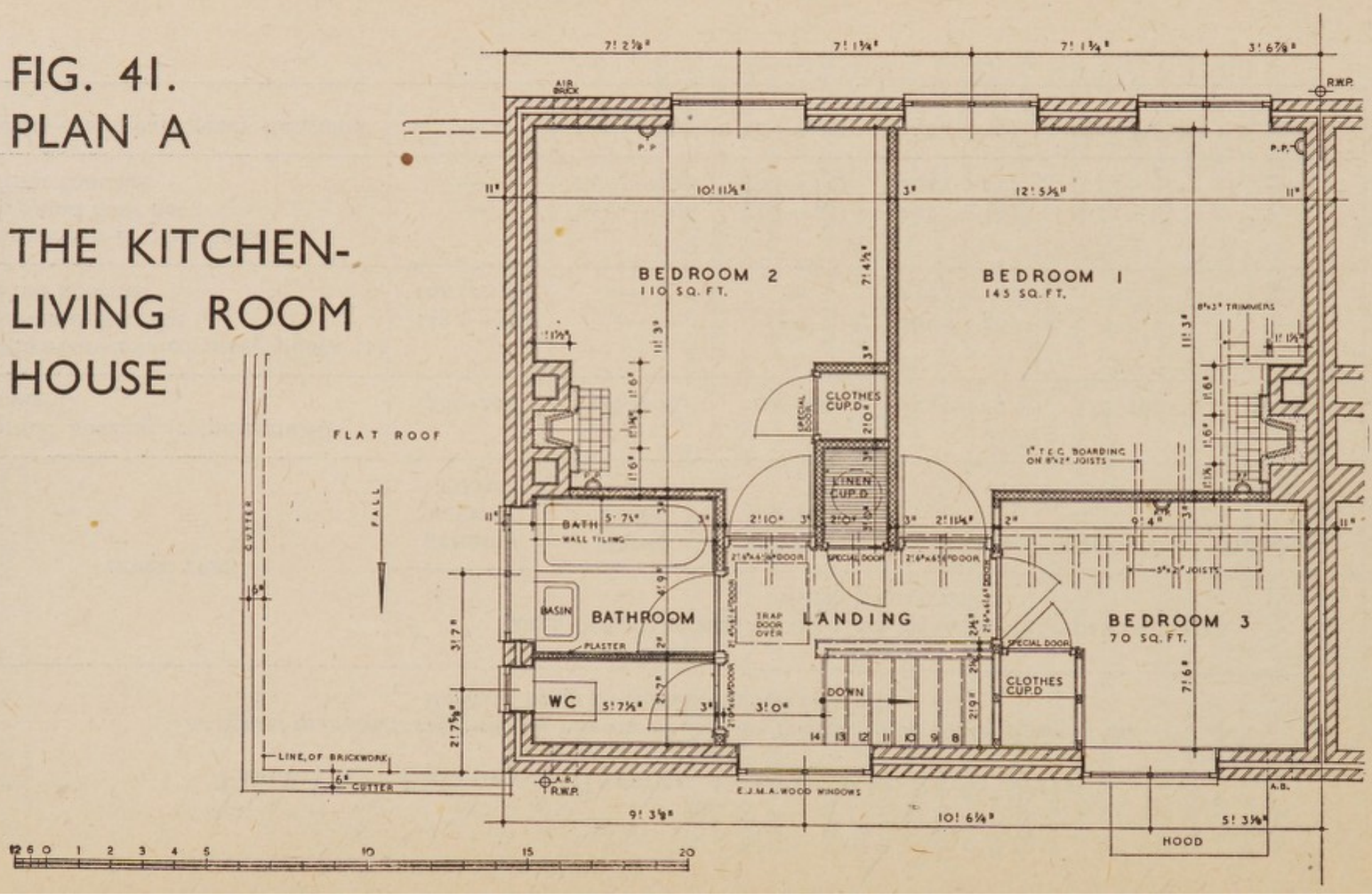
TABLE VIII. EMERGENCY HOUSING: COMPARATIVE ROOM SIZES

The figures in brackets represent the increase or decrease relative to the lowest figure of the standard range for normal English housing

HOUSE TYPE	AREA IN SQUARE FEET (ROOM SIZES INCLUDE BUILT-IN CUPBOARDS WHERE PROVIDED)					
	KITCHEN LIVING ROOM	LIVING ROOM	WORKING KITCHEN	BEDROOM 1	BEDROOM 2	BEDROOM 3
Normal housing (recommended range)	180–200	180–200	90–100	135–150	110–120	70–80
English sub-divided house (Block 11)						
Ground floor flat	143 (−37)	—	—	165 (+30)	—	—
First floor flat	144 (−36)	—	—	139 (+ 4)	—	70
Scottish sub-divided house						
Ground floor flat	—	141 (−39)	75 (−15)	122 (−13)	101 (−9)	—
First floor flat	—	147 (−33)	75 (−15)	104 (−21)	101 (−9)	—
Factory-made emergency bungalow	—	151 (−29)	81 (− 9)	132 (− 3)	132 (+22)	—

FIG. 41.
PLAN A

THE KITCHEN-LIVING ROOM HOUSE



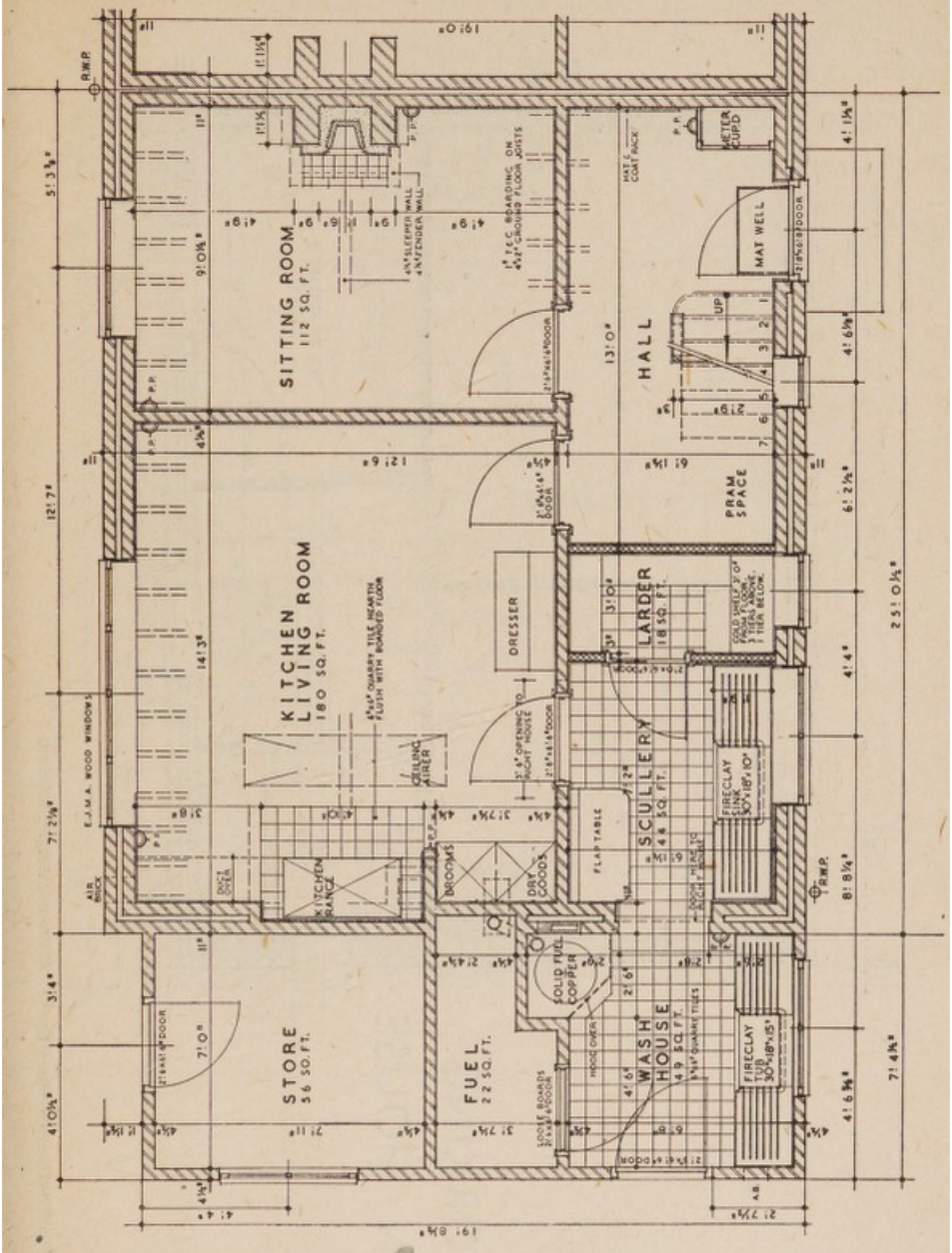
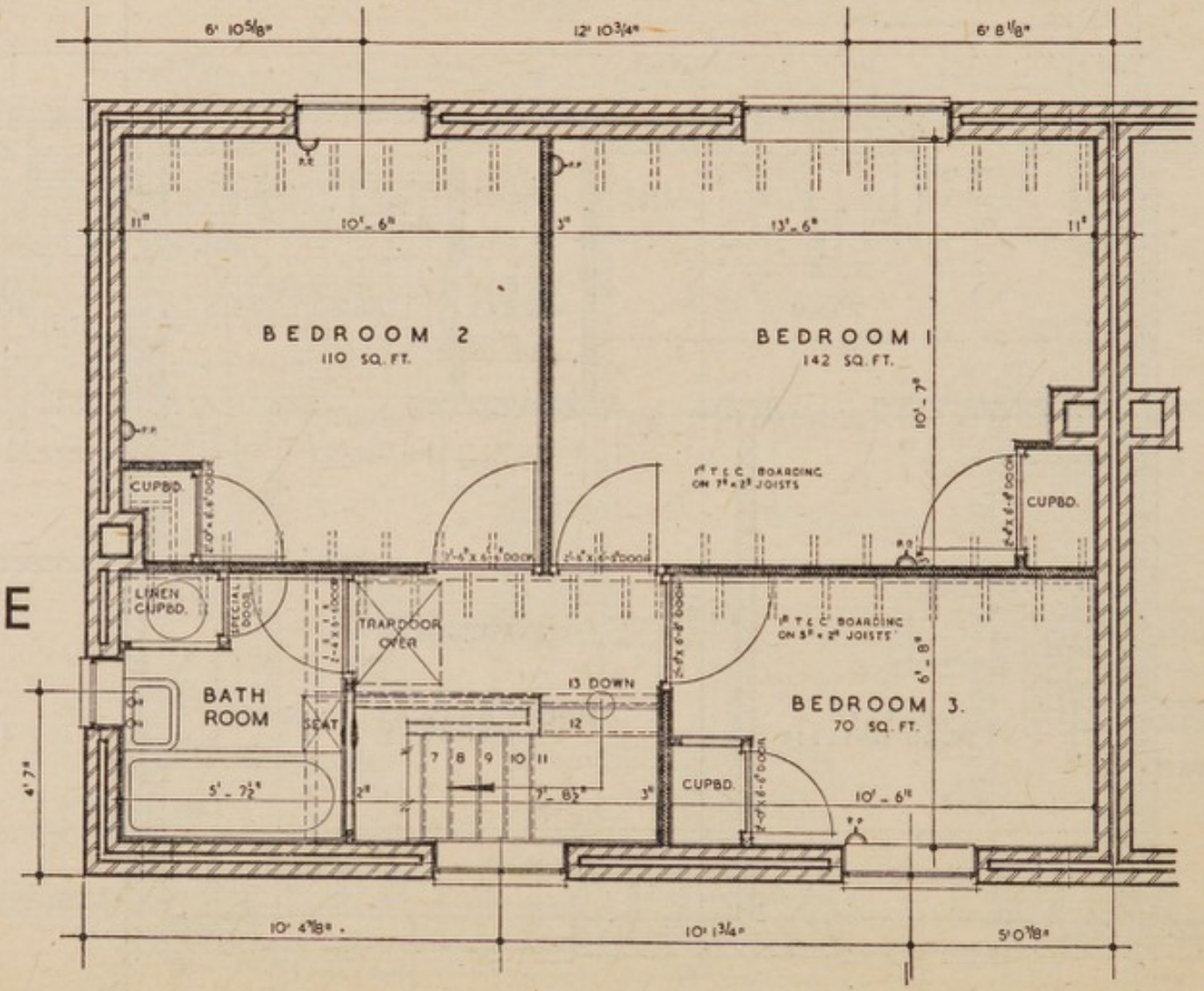
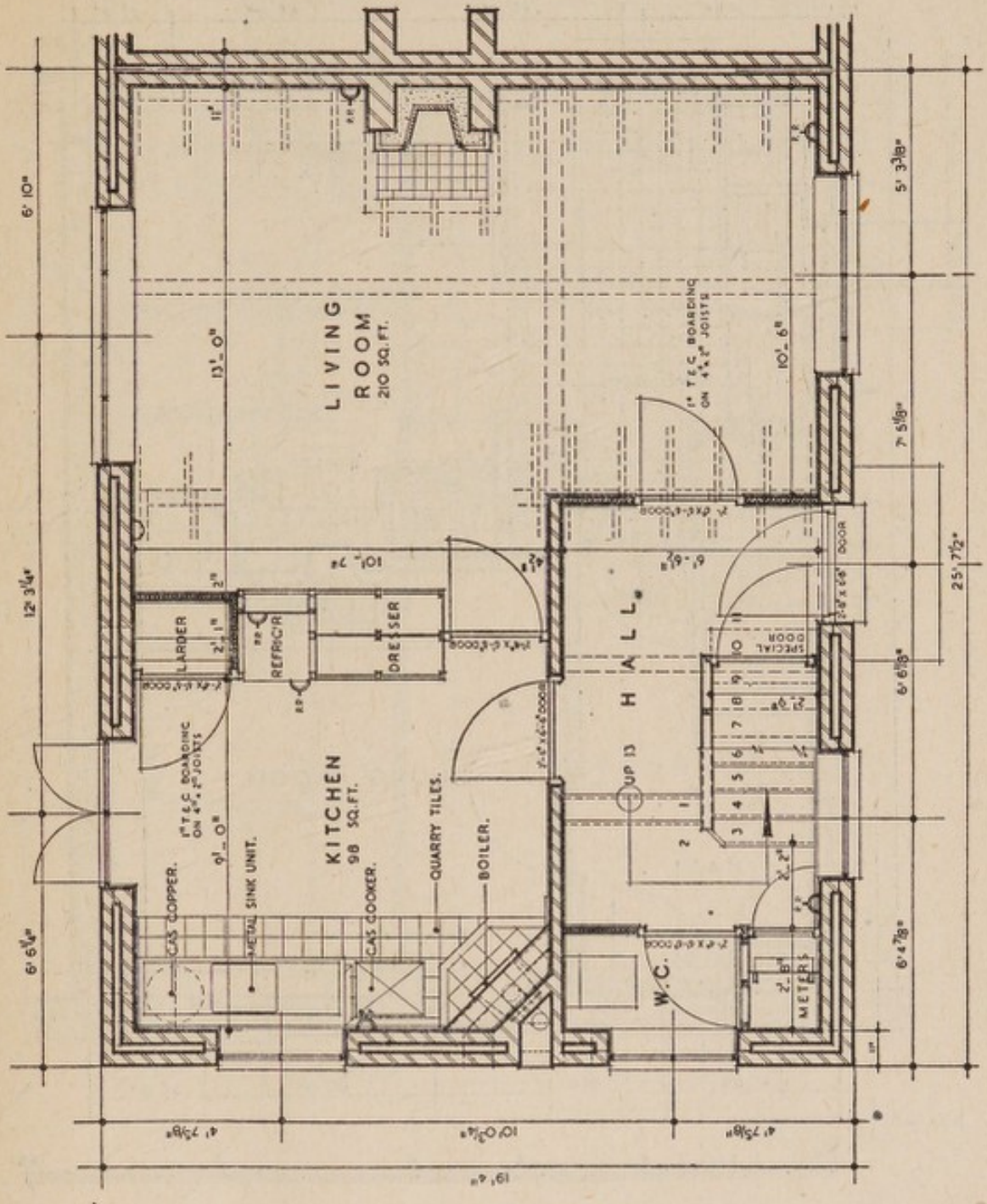

SITTING ROOM
112 SQ. FT.
KITCHEN
LIVING ROOM
180 SQ. FT.
HALL
PRAM SPACE
LARDER
18 SQ. FT.
SCULLERY
46 SQ. FT.
WASH HOUSE
49 SQ. FT.
STORE
56 SQ. FT.
FUEL
22 SQ. FT.
DRESSER
MAT WELL
METER CUPD
KITCHEN RANGE
BROOMS
DRY GOODS
FLAP TABLE
SOLID FUEL COPPER
FIRECLAY SINK 30"x18"x10"
FIRECLAY TUB 30"x18"x15"
CEILING AIRER
R.W.P.
E.J.M.A. WOOD WINDOWS
AIR BRICK
DUCT OVER
HOOD OVER
LOOSE BOARDS
UP

FIG. 42.
PLAN B

THE WORKING KITCHEN HOUSE




LIVING ROOM
210 SQ.FT.
KITCHEN
98 SQ.FT.
HALL
W.C.
LARDER
REFRIGR.
DRESSER
CAS COPPER.
METAL SINK UNIT.
CAS COOKER.
QUARRY TILES.
BOILER.
UP 13
METER
SPECIAL DOOR
1" T.&G. BOARDING ON 4"x2" JOISTS
13'-0"
10'-6"
9'-0"
12' 3¼"
6' 10"
6' 6¼"
5' 3⅜"
7' 5⅛"
6' 6⅛"
6' 4⅞"
25'-7½"
19'-4"
10'-0¾"

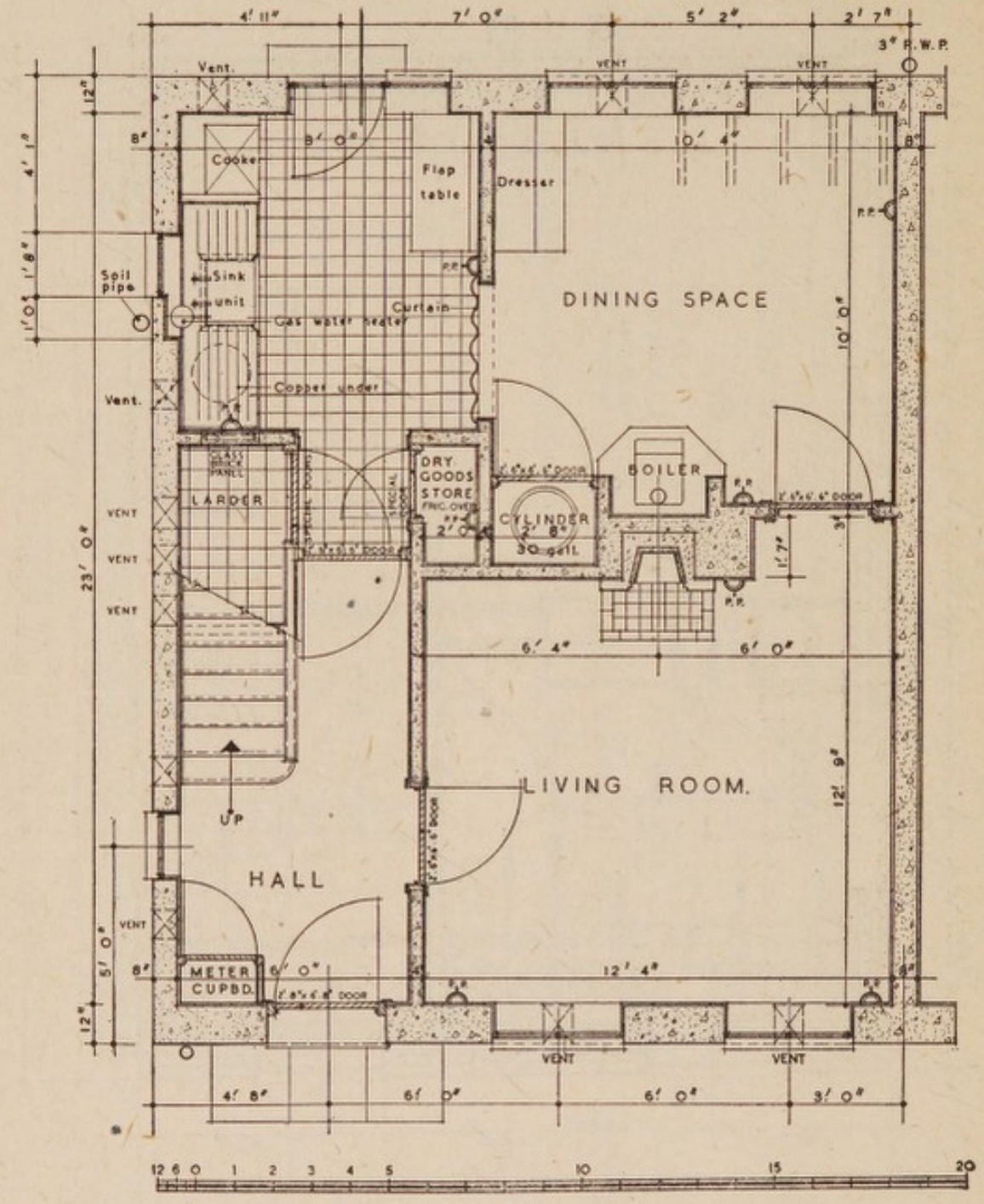
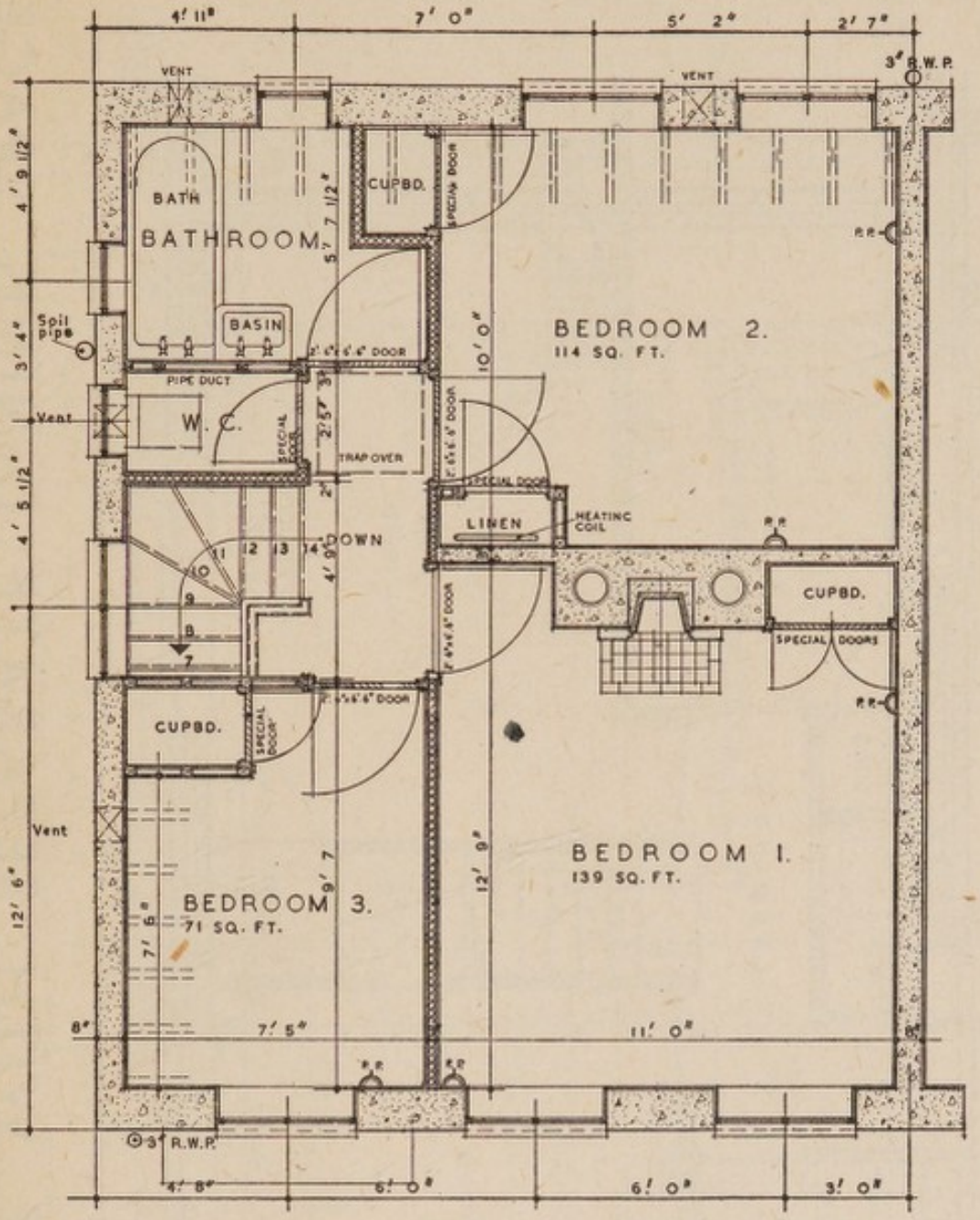


FIG. 43.

PLAN C THE

WITH

THE STANDARD



ALL WALLS 8" TO FOAM SLAG CONSTRUCTION HOUSE .

WORKING KITCHEN HOUSE
SEPARATE DINING SPACE

DEMONSTRATION PLAN

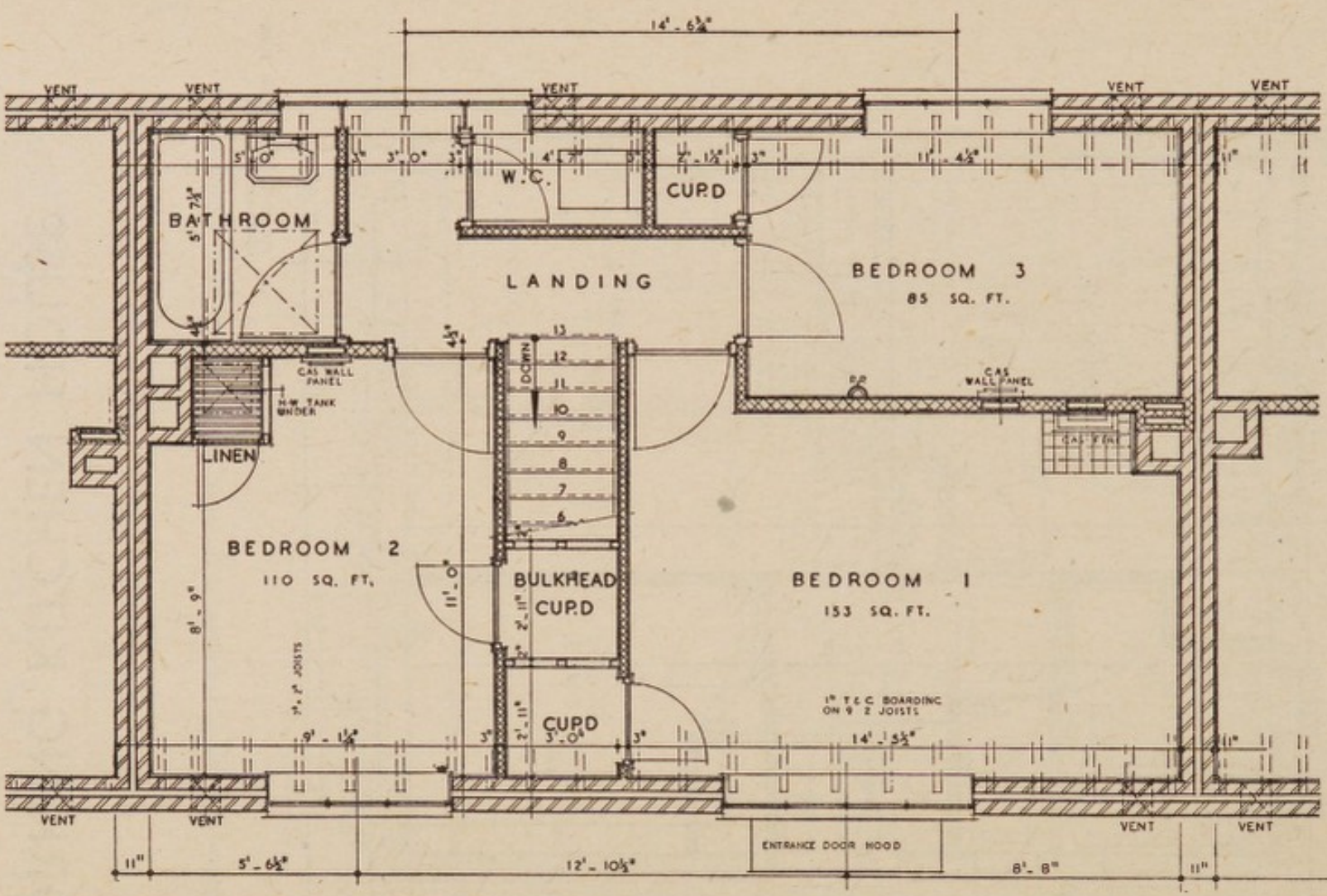


FIG. 44.
PLAN D

TERRACE HOUSE WITH SEPARATE DINING SPACE

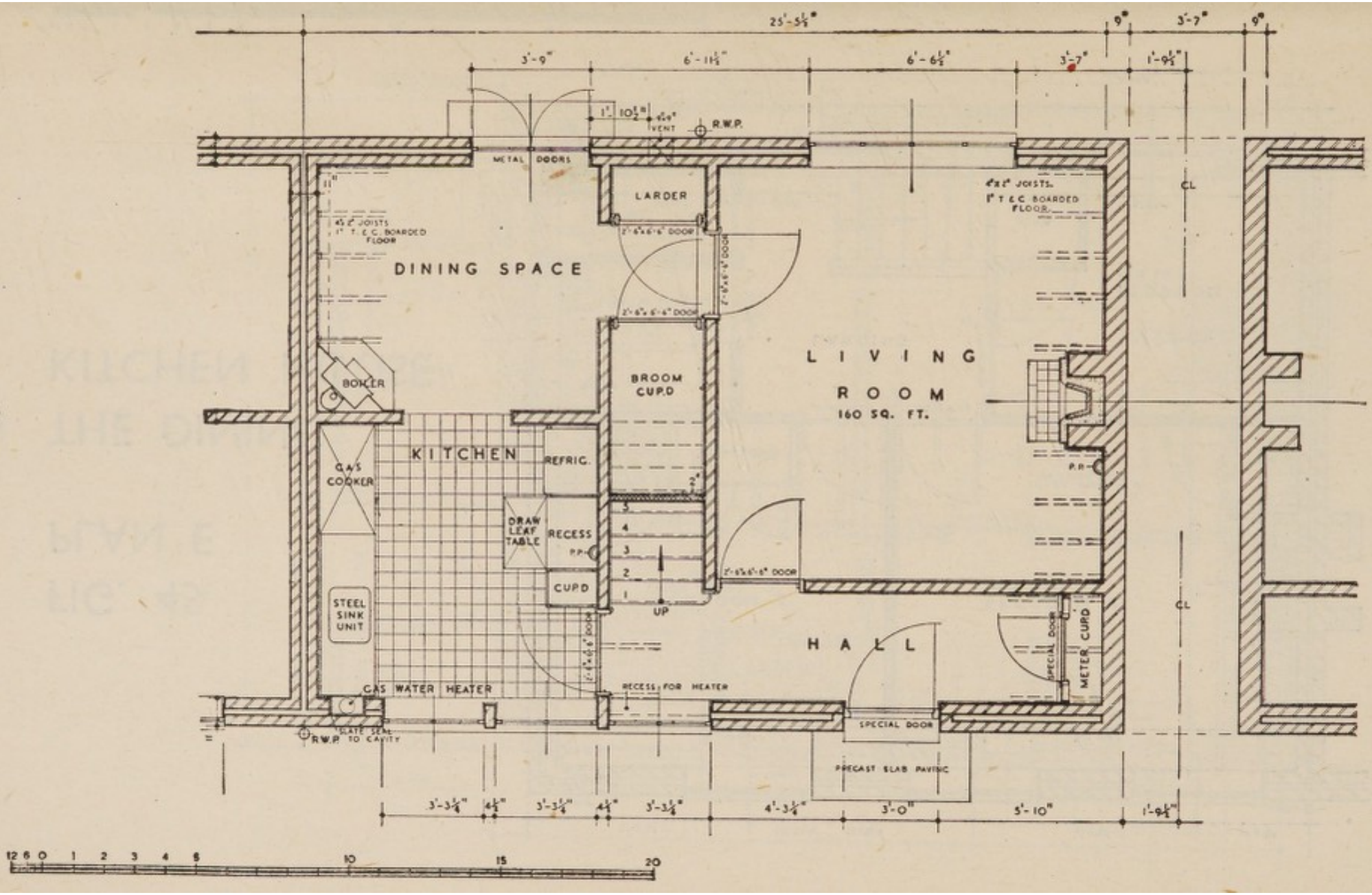
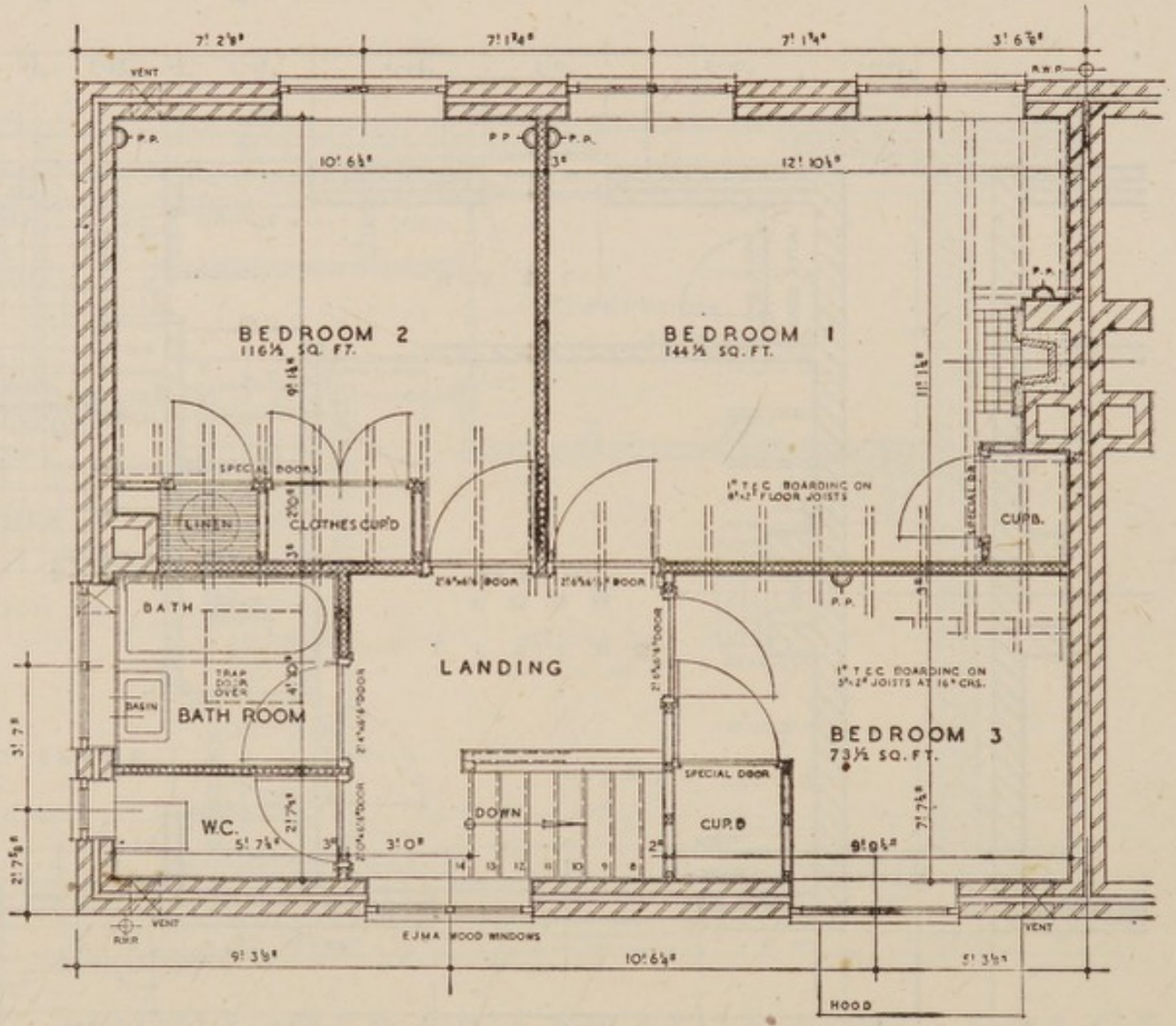
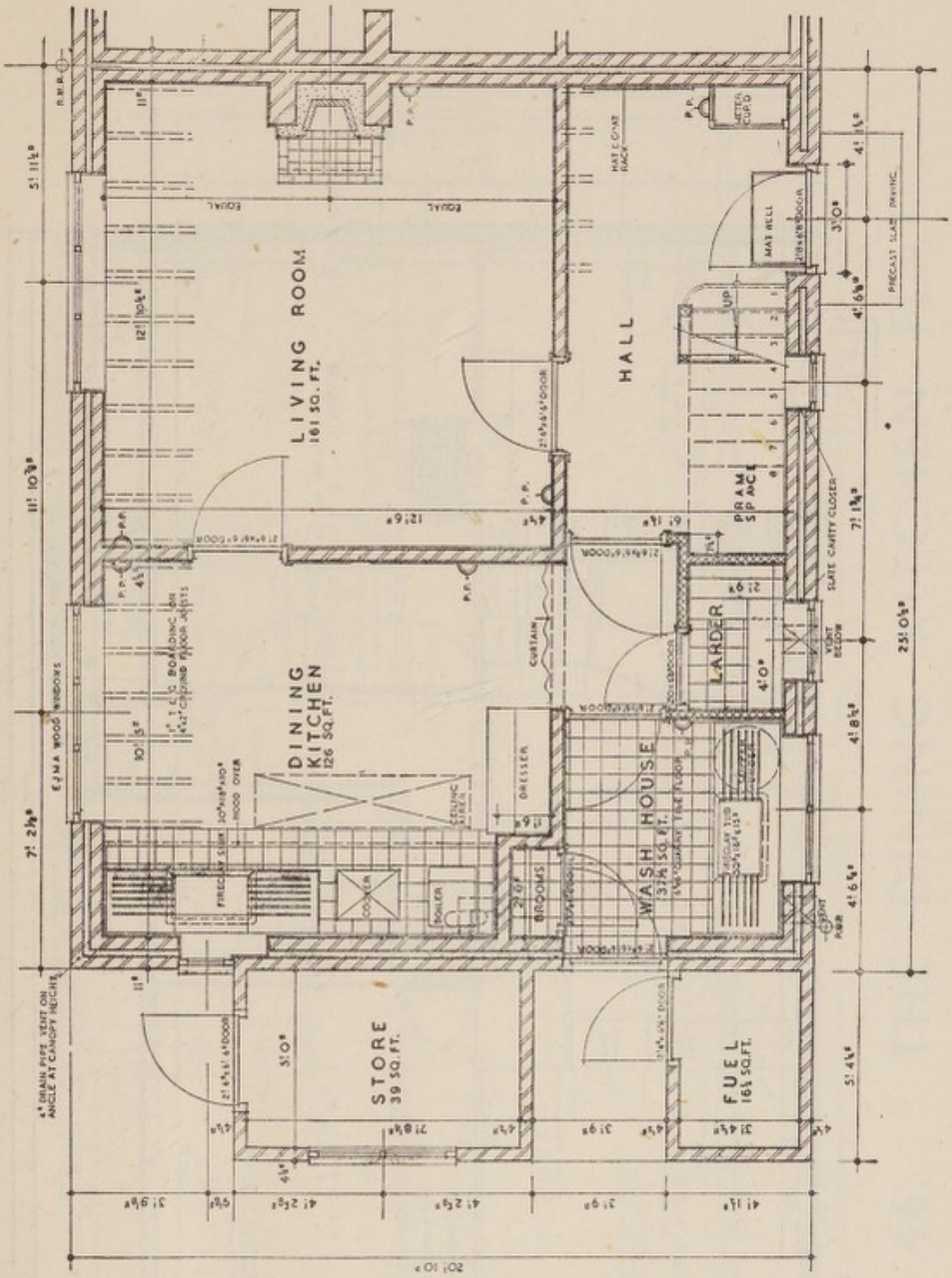

25'-5½"
9"
3'-7"
9"
3'-9"
6'-11½"
6'-6½"
3'-7"
1'-9½"
1" 10½" R
4½" VENT
R.W.P.
METAL DOORS
LARDER
4"x2" JOISTS
1" T & G. BOARDED FLOOR
CL
4"x2" JOISTS
1" T & G. BOARDED FLOOR
DINING SPACE
2'-6"x6'-6" DOOR
2'-6"x6'-6" DOOR
BOILER
BROOM CUP'D
L I V I N G
R O O M
160 SQ. FT.
P.P.
KITCHEN
REFRIG.
GAS COOKER
DRAW LEAF TABLE
RECESS
P.P.
CUP'D
STEEL SINK UNIT
UP
2'-6"x6'-6" DOOR
2'-6"x6'-6" DOOR
H A L L
SPECIAL DOOR
METER CUP'D
CL
GAS WATER HEATER
RECESS FOR HEATER
SLATE SEAL
R.W.P. TO CAVITY
SPECIAL DOOR
PRECAST SLAB PAVING
3'-3¼"
4½"
3'-3¼"
4½"
3'-3¼"
4'-3¼"
3'-0"
5'-10"
1'-9½"
12 6 0 1 2 3 4 5 10 15 20

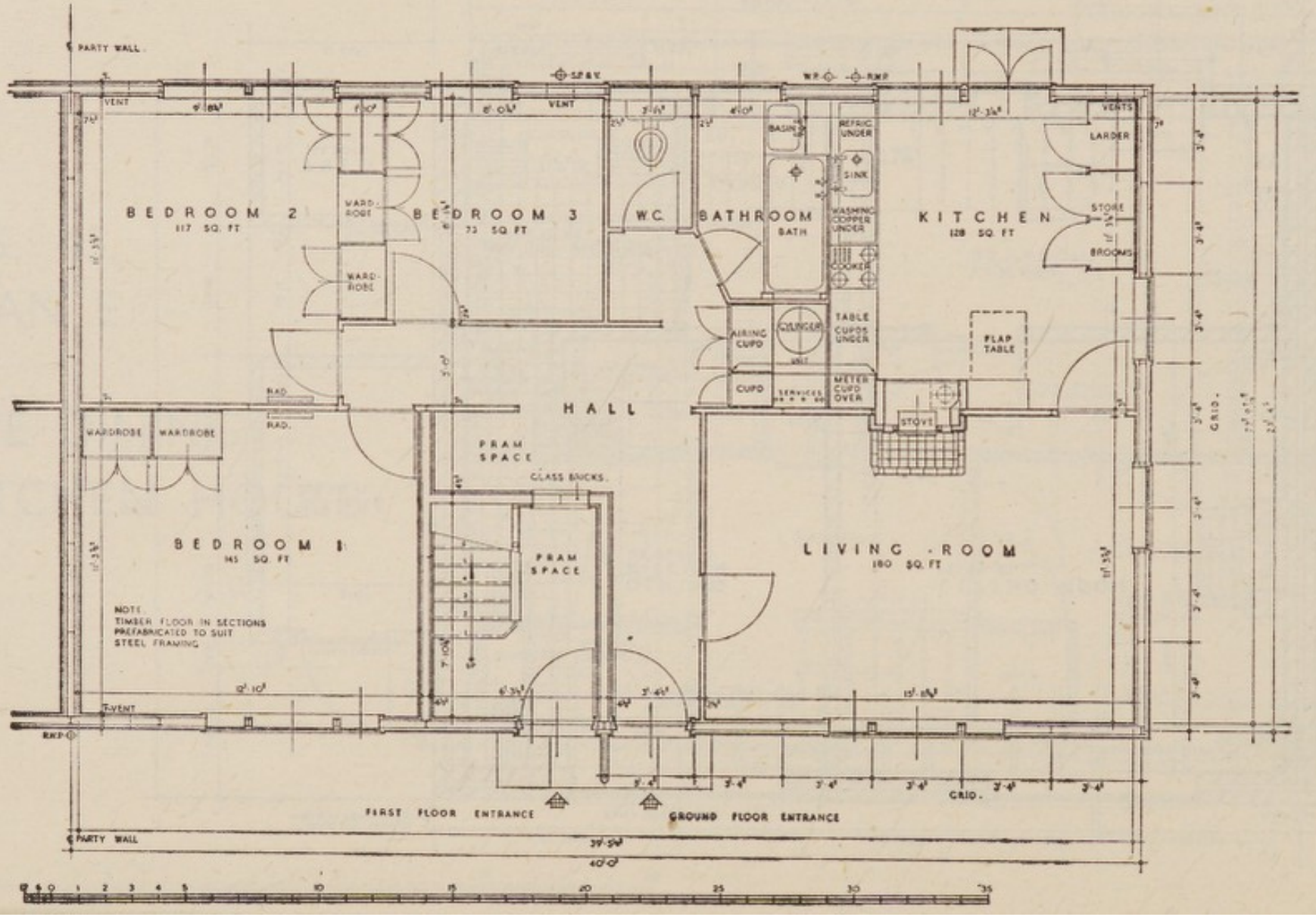
FIG. 45.
PLAN E

THE DINING KITCHEN HOUSE



12 6 0 1 2 3 4 5 10 15 20


LIVING ROOM
161 SQ. FT.
HALL
DINING KITCHEN
126 SQ.FT.
LARDER
WASH HOUSE
37½ SQ. FT.
STORE
39 SQ. FT.
FUEL
16½ SQ.FT.
PRAM SPACE
BROOMS
METER CUPD
MAT WELL
PRECAST SLAB PAVING
SLATE CAVITY CLOSER
EJMA WOOD WINDOWS
4" DRAIN PIPE VENT ON ANGLE AT CANOPY HEIGHT
20' 10"


PARTY WALL
VENT
VENT
SP&V
WP
RWP
BEDROOM 2
117 SQ. FT
WARD-ROBE
WARD-ROBE
BEDROOM 3
72 SQ FT
W.C.
BATHROOM
BATH
BASIN
REFRIG UNDER
SINK
WASHING COPPER UNDER
COOKER
KITCHEN
128 SQ FT
VENTS
LARDER
STORE
BROOMS
AIRING CUPD
CYLINDER
TABLE CUPDS UNDER
FLAP TABLE
CUPD
SERVICES
METER CUPD OVER
STOVE
RAD.
RAD.
HALL
WARDROBE
WARDROBE
PRAM SPACE
GLASS BRICKS.
BEDROOM 1
145 SQ. FT
PRAM SPACE
LIVING - ROOM
180 SQ. FT
GRID.
NOTE.
TIMBER FLOOR IN SECTIONS
PREFABRICATED TO SUIT
STEEL FRAMING
T-VENT
RWP
FIRST FLOOR ENTRANCE
GROUND FLOOR ENTRANCE
GRID.
PARTY WALL
39'-5½"
40'-0"
0 1 2 3 4 5 10 15 20 25 30 35

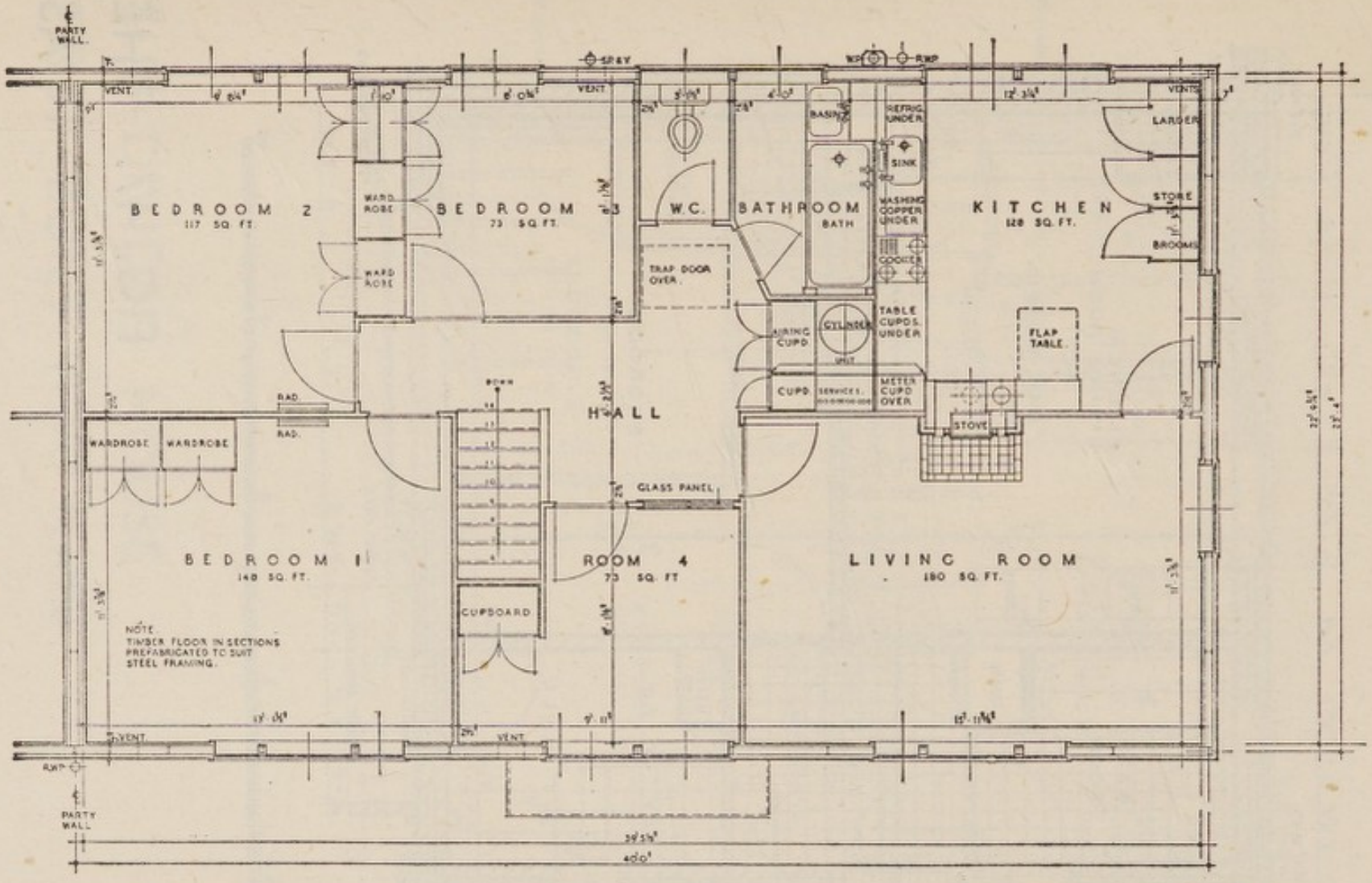


FIG. 46. THE DINING KITCHEN FLAT

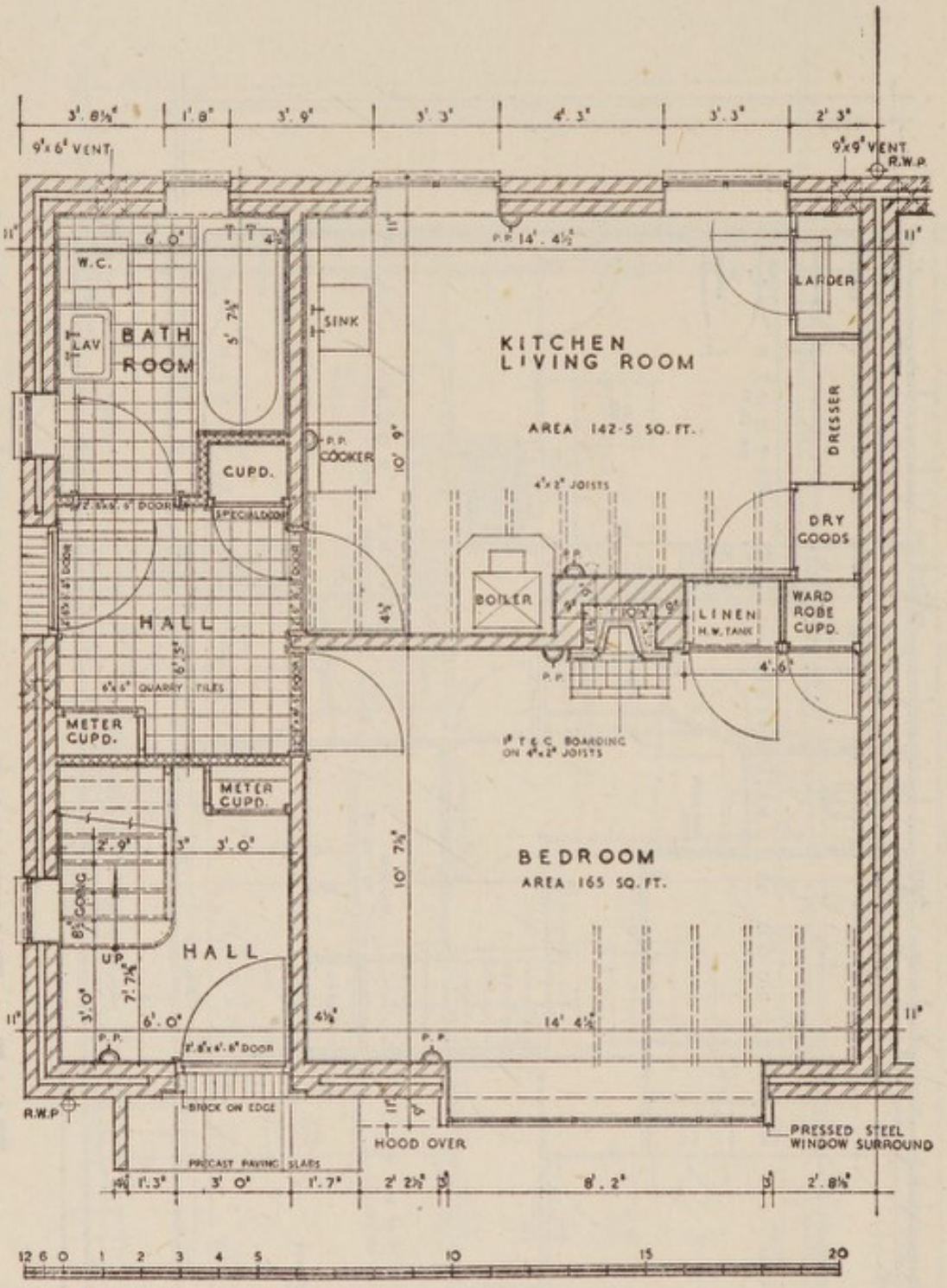
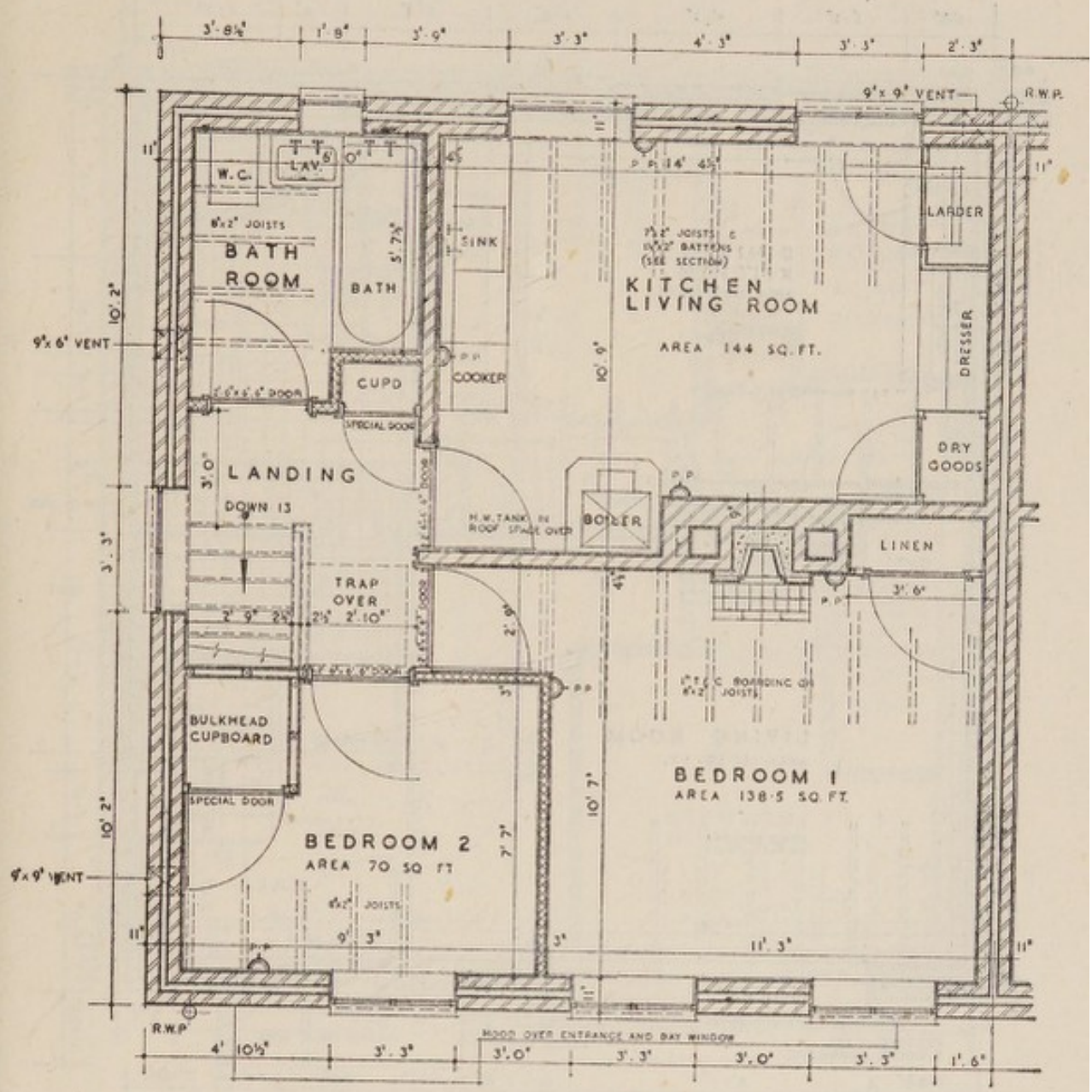

KITCHEN
LIVING ROOM
AREA 142·5 SQ. FT.
BEDROOM
AREA 165 SQ. FT.
BATH ROOM
W.C.
LAV
SINK
COOKER
CUPD.
HALL
HALL
METER CUPD.
METER CUPD.
LARDER
DRESSER
DRY GOODS
BOILER
LINEN
H.W. TANK
WARD ROBE CUPD.
6"x6" QUARRY TILES
1" T. & G. BOARDING ON 4"x2" JOISTS
4"x2" JOISTS
9"x6" VENT
9"x9" VENT
R.W.P.
R.W.P.
BRICK ON EDGE
PRECAST PAVING SLABS
HOOD OVER
PRESSED STEEL WINDOW SURROUND
UP
3'. 8½"
1'. 8"
3'. 9"
3'. 3"
4'. 3"
3'. 3"
2' 3"
1'. 3"
3' 0"
1'. 7"
2' 2½"
8'. 2"
2'. 8½"

FIG. 47. THE
AS



SUB-DIVIDED HOUSE
FIRST BUILT (TWO FLATS)

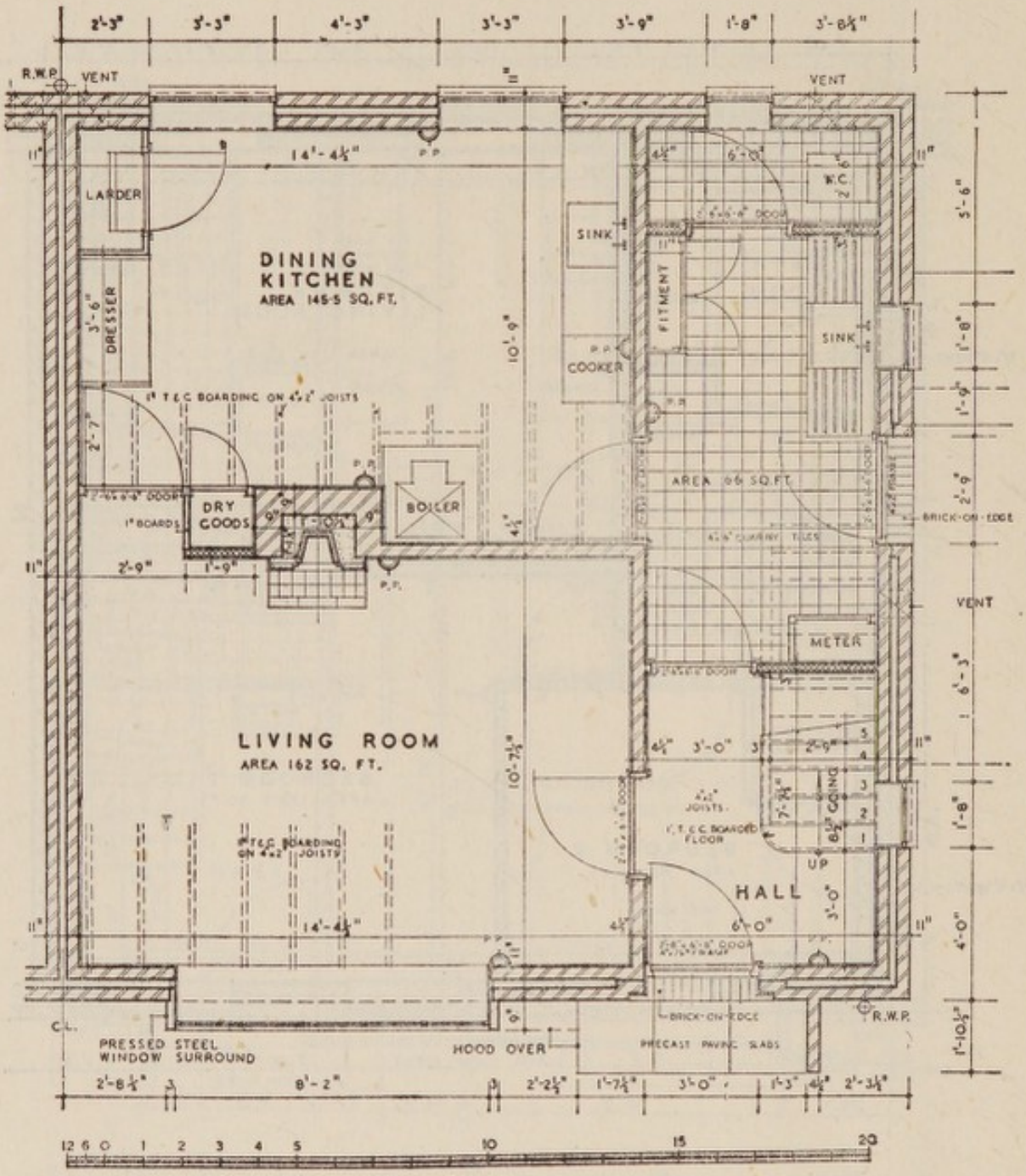
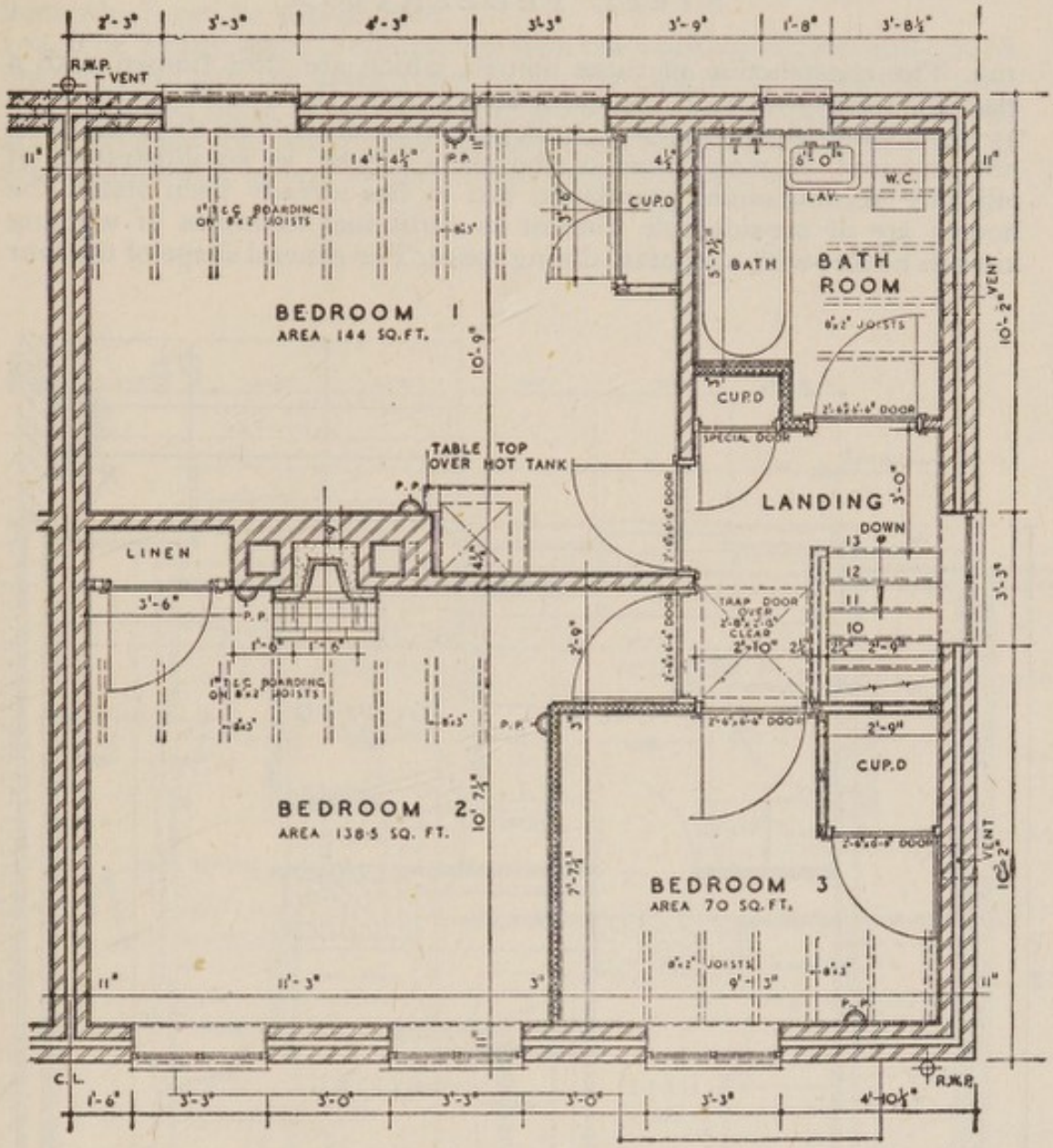

DINING KITCHEN
AREA 145·5 SQ. FT.
LARDER
DRESSER
SINK
FITMENT
COOKER
W.C.
SINK
AREA 66 SQ. FT.
BRICK-ON-EDGE
VENT
METER
DRY GOODS
BOILER
LIVING ROOM
AREA 162 SQ. FT.
HALL
UP
R.W.P.
PRESSED STEEL WINDOW SURROUND
HOOD OVER
PRECAST PAVING SLABS
14'-4½"
10'-9"
10'-7½"
6'-0"
3'-0"
8'-2"

FIG. 48. THE
AS

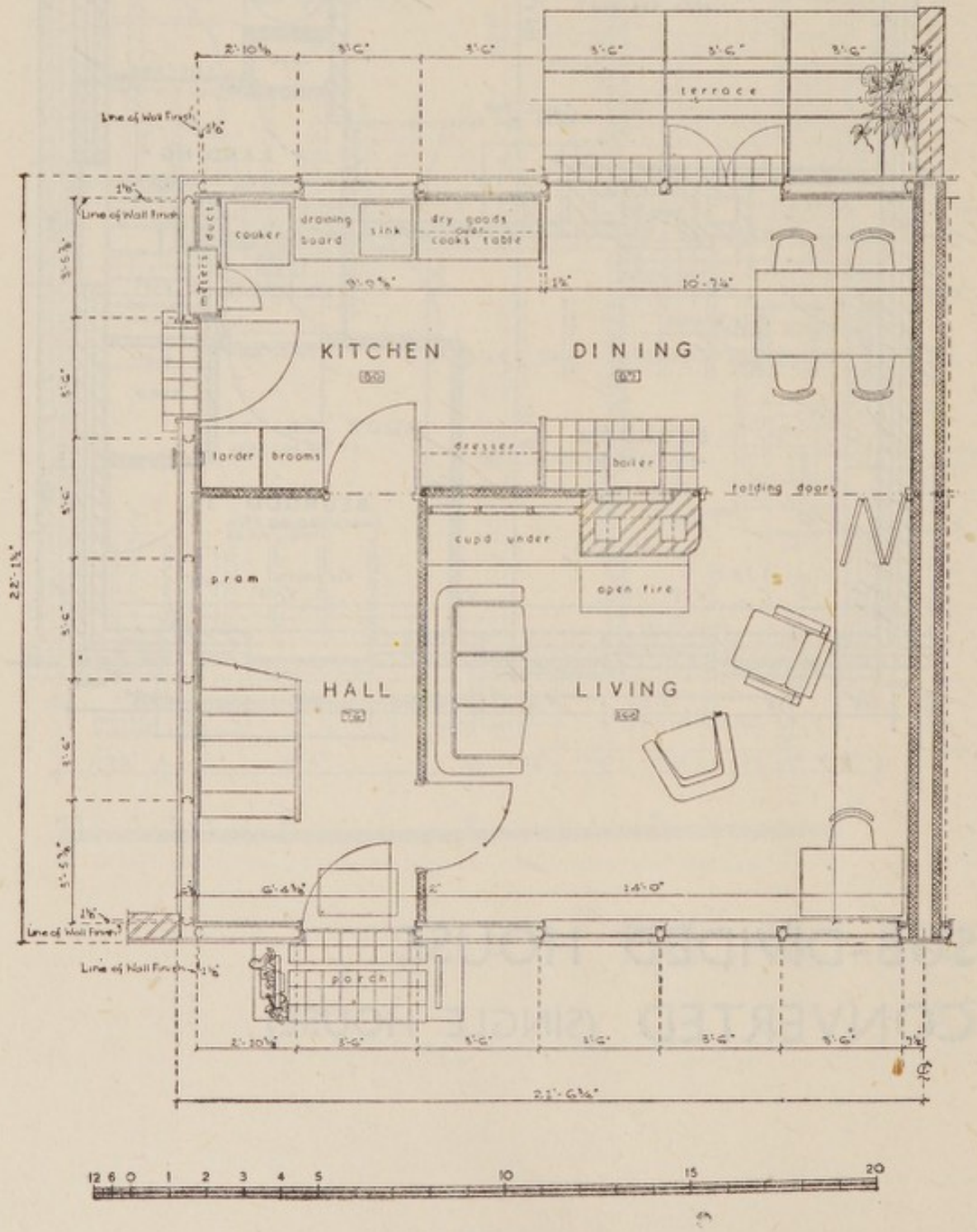


SUB-DIVIDED HOUSE CONVERTED (SINGLE HOUSE)

APPENDIX A

HOUSES BUILT BY THE BRITISH IRON AND STEEL FEDERATION

103. The construction of these houses, which are steel framed with a cladding mainly of steel, has been described in Section II (paragraphs 35–47). Since the houses were built by private enterprise, the plans were not prepared, as were those of the other blocks, as an illustration of officially recommended standards, but as has already been stated the houses are of considerable interest as additional examples of working kitchen houses with a separate dining space. The general shape of the four



houses is approximately square, and is therefore intermediate between the comparable houses in Block 8, which are wide fronted, and the narrow fronted standard demonstration houses in Blocks 1, 2, 3, 6 and 10. The houses also show the nearest approach to a completely "open" ground floor which can be sub-divided.

104. The dining space is continuous with the working kitchen and can be opened clear into the living room by sliding back a set of folding doors.

105. Only the plans of Block 12 (the block with brick clad lower storey) are given here. The differences between these plans and those of Block 13 are insignificant, as will be seen from Table IX (overleaf).

FIG. 49.

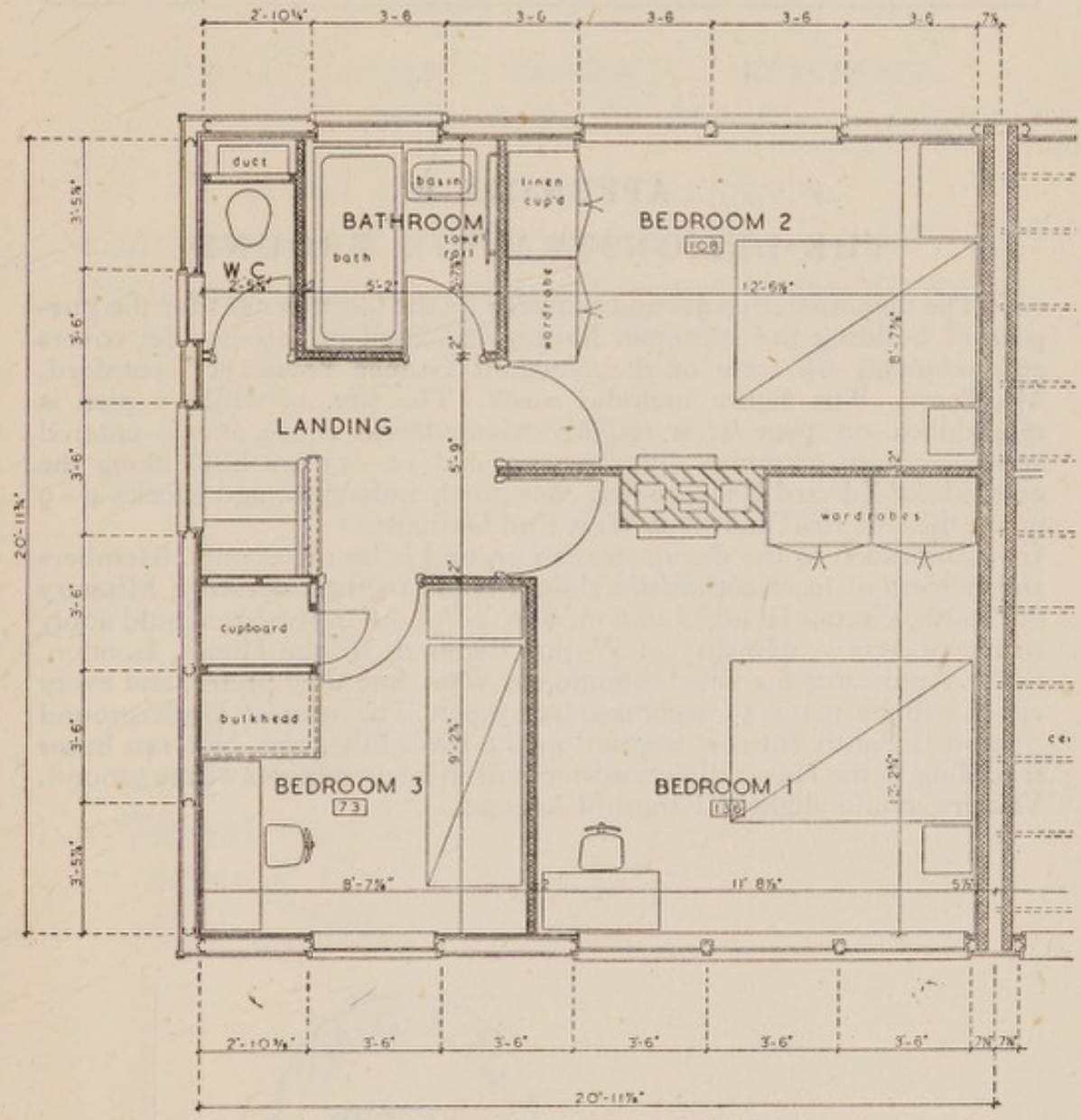


TABLE IX. THE WORKING KITCHEN HOUSE WITH SEPARATE DINING SPACE (BLOCKS 12 AND 13)

FLOOR AREAS

In square feet (including built-in cupboards where provided.)

ROOM	RECOMMENDED RANGE	BLOCK 12	BLOCK 13
Living room plus dining space ..	225–245	243	255
Working kitchen ..	90–100	85	80
Bedroom 1	135–150	136	136
Bedroom 2	110–120	108	108
Bedroom 3	70– 80	73	73

APPENDIX B

THE DEMONSTRATION GROUND

106. The demonstration ground acquired by the Government for the purpose of building the specimen houses described in this booklet covers approximately 6½ acres of the Northolt Grange Estate at Greenford, Middlesex. The figure includes roads. The site, of which a plan is reproduced on page 4, is roughly triangular in shape and is entered at its southern extremity. Blocks 1 – 3 and 10 – 13 are built along the east side of Edward Road, which runs north and south, and Blocks 4 – 9 are in the side road known as West End Gardens.

107. Admission to the demonstration ground is by ticket only. Members and officers of local authorities should apply to the Secretary, Ministry of Health, Caxton House, London, S.W.1. All other persons should apply to the Secretary, Ministry of Works, Lambeth Bridge House, London, S.E.1. Applicants for tickets should say what date they prefer, and every effort will be made to accommodate them. The nearest Underground Station is South Harrow Station on the Piccadilly tube. No. 140 buses travelling in the Hayes direction stop within a few minutes of the ground. Visitors should alight at Kingshill Avenue.

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MINISTRY OF HEALTH

PUBLICATIONS ON HOUSE DESIGN

RURAL HOUSING
Report of the Central Housing Advisory Committee
1944. 1s. (1s. 2d.)

DESIGN OF DWELLINGS
Report of the Central Housing Advisory Committee.
1944. 1s. (1s. 2d.)

PRIVATE ENTERPRISE HOUSING
Report of the Central Housing Advisory Committee.
1944. 1s. (1s. 2d.)

MODEL BYELAWS: SERIES IV. BUILDINGS
1938. 1s. 6d. (1s. 8d.)

TOWN AND COUNTRY PLANNING
Model Clauses for use in the Preparation of Schemes (with Notes).
(Note: The clauses are now under revision by the Ministry of Town and Country Planning)
1939. 2s. (2s. 2d.)

DEPARTMENT OF HEALTH FOR SCOTLAND

PUBLICATIONS

PLANNING OUR NEW HOMES
Report of the Scottish Housing Advisory Committee.
1944. 3s. (3s. 5d.)

DISTRIBUTION OF NEW HOUSES IN SCOTLAND
Report of the Scottish Housing Advisory Committee.
1944. (Cmd, 6552). 2s. (2s. 3d.)

Prices in brackets include postage

HIS MAJESTY'S STATIONERY OFFICE

HOUSING MANUAL 1944
Published for the Ministry of Health and the Ministry of Works.
2s. (2s. 2d.)

HOUSING MANUAL 1944
TECHNICAL APPENDICES
Published for the Ministry of Health and the Ministry of Works.
1s. 6d. (1s. 8d.)

HOUSE CONSTRUCTION
(*Post-War Building Studies : No.* 1)
By an Inter-Departmental Committee appointed by the Minister of Health, the Secretary of State for Scotland and the Minister of Works. 2s. (2s. 3d.)

THE USE OF STANDARDS IN BUILDING
First Progress Report of the Standards Committee
Published for the Ministry of Works.
6d. (7d.)

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