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A construction scheme with large panels for the tropics

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Industrialised methods of construction have to be effectively utilised for overcoming the acute shortage of housing in this country. Among the many possible methods, large panel construction is one which has found wide acceptance in many countries, because of the considerable speed of construction that can be achieved. The paper discusses a scheme which makes optimum use of panels and conventional materials, and also eliminates the problems of thermal insulation and leak-proof joints for external walls, normally associated with fully prefabricated large panel construction. Besides, the scheme gives full freedom to the architect for employing the elevation of his choice.

Industrialised methods of construction which lead to speedier construction, effective quality control, and reduced labour force, and enable detailed appraisal of various construction problems before the commencement of the work are required to overcome the prevailing acute shortage of housing in this country. Among the several possible methods, it is to be noted that large panel construction is one which has been widely adopted in many countries.

Thermal insulation and leak-proof jointing details for external walls are known to be major problems in large panel construction. To improve thermal efficiency, cellular or sandwich construction is adopted. The thermal performance of various types of wall specifications and of 23-cm thick brick-wall calculated in accordance with the method described in the Indian Standard Guide for Heat Insulation of Non-industrial Buildings, IS: 3792-1966, is given in *Table* 1. It may be observed that the thermal performance of 15-cm thick sandwich panel with foamed concrete, or thermocole, or 20-cm thick cavity wall is comparable to a 23-cm thick brick-wall. But the cost of the sandwich and cellular concrete panel is considerably high. As no suitable insulation materials are available at reasonable rates, brick continues to form an economical material for external walls. Further this eliminates the problem of water penetration through joints usually associated with large panel construction. Therefore, a scheme using large panels for load-bearing cross-walls and floor/roof, with facade walls in brickwork, has been worked out.

Details of the scheme

The salient features of the construction scheme are described here.

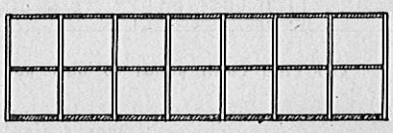
Foundation: The system being of a load-bearing wall type, strip-type foundation is adopted. In both in situ and precast foundations, excavation of trench, levelling and compaction of base, etc are common features. However, in the case of precast foundations uniform distribution of load may not be attainable because of undulations in the base. Further special joint details between precast strips will be required. In view of these factors as well as from considerations of economy the traditional type of foundation is adopted.

Cross-wall: The cross-walls are load-bearing with room-sized prefabricated concrete panels coupled at the intersecting longitudinal walls. The panels are cast at the site in a battery of concrete moulds with necessary provision for fenestration and jointing. The other advantages of the battery casting are:

(*i*) it produces self-finished surface on both faces, thereby avoiding the need for screeding and trowelling associated with horizontal casting

(*ii*) it reduces handling stresses

(*iii*) it ensures better dimensional control.



Plan

Fig 1 Typical construction scheme showing precast cross-walls and brick facades

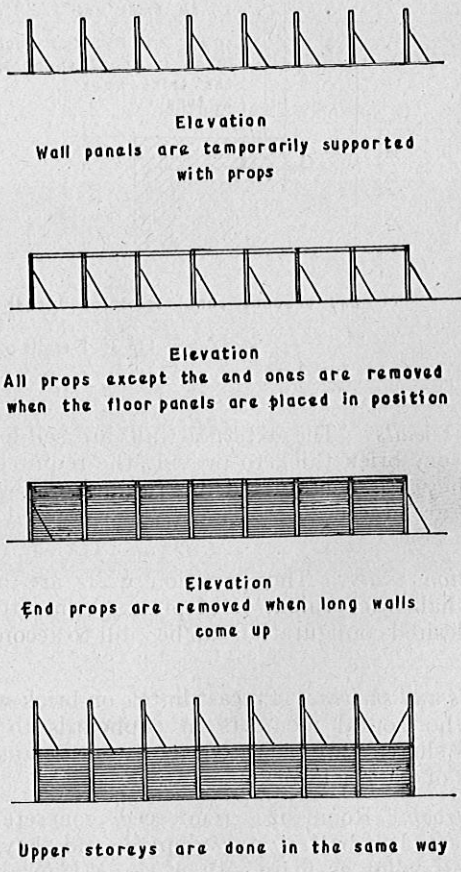


Fig 2 Typical construction sequence

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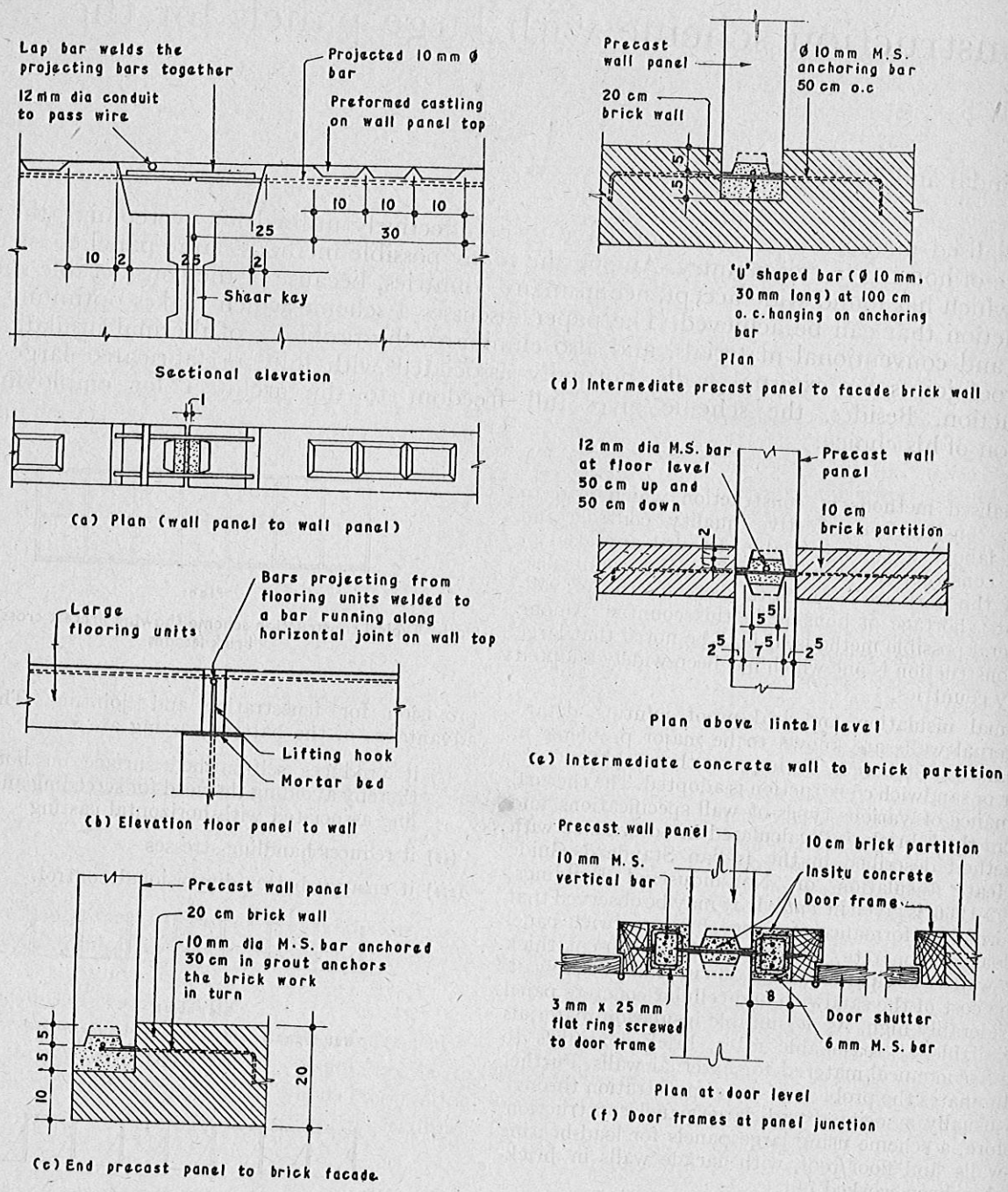

Fig 3 Details of jointing among the various components

Facade walls: The external walls are self-load-bearing and one-brick thick to provide the required insulation. They are constructed in the normal way, and various architectural treatments as required can be given.

Partition walls: The partition walls are of either in situ, half-brick thick, or of precast concrete. Brick-wall of desired configuration can be built to accommodate shelves.

Lintels and shelves: Precast lintels on brick-work and precast horizontal members in cupboards to provide rows of shelves are adopted to avoid delays in the progress of the brickwork.

Floor/roof: Room-size reinforced concrete panels prefabricated in battery are adopted, and they present a jointless soffit as in in situ work. A typical lay-out plan based on the scheme is shown in *Fig* 1.

Transport of panels

Since the wall panels contain nominal reinforcement for temperature and shrinkage stresses only, they should be transported in either a vertical or an inclined position on a special frame fitted to a bogey chassis. Floor slabs are also transported in a similar way.

Erection

With the help of a crane, the wall panels are placed on the plinth in their respective positions. Each panel is supported by two telescopic props before the crane is relieved. The props are subsequently used to bring the panels to the true-to-plumb position.

The protruding steel bars provided in the panels at the top are welded on to additional bars in order to join the adjacent panels. The floor slabs are then placed on the cross-walls. All the props are retained until the

TABLE I Thermal performance and cost index for external walls

Serial no	Thermal insulation	K, Kcal/m h°c	Wall section, cm	$\frac{Q}{U}$, hour	Thermal damping, per cent	Comparative cost index
1	Self-insulating	0·697	23 Brick	19·37	75·0	100
2	Guna tiles	0·697	4·74	7·86	35·0	170
3	Hourdi blocks	0·900	3·5 8 3·5	8·06	35·0	180
4	Thermocole	0·027	4·74	20·32	78·0	260
5	Foam concrete	0·094	4·74	20·38	77·1	210
6	Sinter flash aggregate	0·290	4·74	11·25	40·0	150
7	Self-insulating	1·300	1:2:4 15 concrete	7·90	35·0	165
8	Air gap		10·55	18·34	73·5	170
9	Self-insulating	0·750	η°15 fines concrete	8·62	35·5	110

longitudinal walls are built. All vertical and horizontal joints in the panels are concreted in one single operation. The props excepting those at the end walls are then removed. The same sequence of construction is repeated for the upper storeys. All the wall and floor panels are provided with threaded sockets to which the props are fixed. The construction sequence is illustrated in *Fig* 2.

Joints

The details of jointing among the various components are given in *Fig* 3. A prototype house, *Figs* 4, 5 and 6,

Fig 4 Transportation of panels

has been built at the Central Building Research Institute in Roorkee using this scheme.

Acknowledgment

The work described forms part of the research programme for the development of large panel prefabrication systems, that is being carried out at the Central Building Research Institute. The paper is published here by kind permission of the Director, Central Building Research Institute, Roorkee.

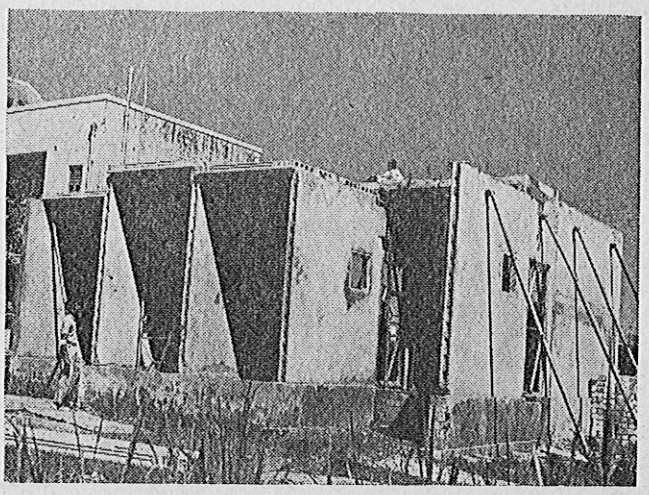

Fig 5 Cross-wall panels erected

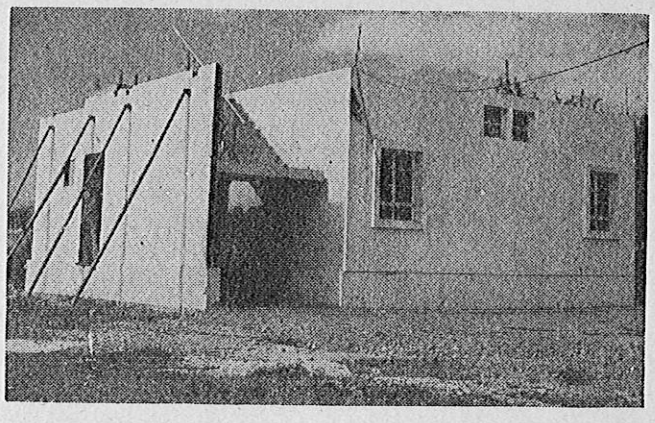

Fig 6 A view of the completed house

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