EXPERIMENTAL, NON-TECTONIC MAISONETTE*

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The theme was elaborated by Dr. MIHÁLY PÁRKÁNYI and Mr. BÉLA SÁMSONDI KISS † (1902—1972).

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1. Design

Nature and scope of the design

The *test building* is a one-family house, an experimental maisonette in non-tectonic construction having a total area of 219.68 m² and a total volume of 605.88 m³.

The test building was first of all destined to give a proof of the universality of the open, non-tectonic structural system, so we elaborated an *architectural and technological variation on a system of non-tectonic bricks.*** The product — the experimental maisonette — goes far beyond illustrating a structural principle since it clearly proves that the *non-tectonic* structures may open a possible way towards open-system industrialization in building.

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In order to prove simultaneously the openness and universality of the structure and the architectural and technological efficiency of the non-tectonic systems, the *test building* — that is, the maisonette containing one two-storey dwelling — *was designed to include at least one example for every essential structural detail occurring in a residential unit.* According to this, simple and composed spaces, stiffened and unstiffened walls, intermediate and top floors, smaller and longer spans, beam grids and beam walls, section-principled walls and slab-principled walls, smaller and bigger heights, cantilever and loggia structures can equally be found in this building.

* Abridged text of a report prepared for UNIDO in 1973

** PÁRKÁNYI, M.: Non-Tectonic Systems. Per. Pol. Arch. Vol. 17. (1973) 4. 121—165.

Characteristic co-ordination dimensions of test building

— *overall dimensions:* (primary-grid dimension)
$(10 \times 18\ M) \times (3 \times 18\ M + 1 \times 12\ M) = 18{,}00\ \text{m} \times 6{,}60\ \text{m}$

— *dimension of grid of cells:* (secondary-grid dimension)
$18\ M \times 18\ M$ or $18\ M \times 12\ M$

— *grid of structural tissue:* (tertiary-grid dimension) $3\ M \times 3\ M$

— *grid of structural details;* (micro-grid dimension)
$\text{mc} \times \text{mc} = 37{,}5\ \text{mm} \times 37{,}5\ \text{mm}$

— *spans:* 6,60 m; 6,00 m; 5,40 m; 4,80 m; 3,60 m

— *heights:*
interior height from top of floor to bottom of grid: $21\ M = 2{,}10$ m
height of cell from bottom of grid to top of floor: $4{,}5\ M = 0{,}45$ m
total height of storey from top of floor to top of floor:
$$25\frac{1}{2}\ M = 2{,}55\ \text{m}$$
total height of building from top of ground-floor to top of roof floor:
$$51\ M = 5{,}10\ \text{m}$$
interior height from top of floor finish to bottom of grid: 2,07m
interior height in gallery from top of ground-floor finish to bottom of roof-floor grid:
$$46\frac{1}{2}\ M = 4{,}65\ \text{m}$$

The formula of double co-ordination: $3\ M = 8$ mc

This formula means that 3 basic module grid units (M = Module = 10 cm) within the structural system correspond to 8 micro grid units (mc = microcell = = 37,5 mm) within the manufacturing apparatus.

Basic dimensions of gypsum surface elements: In open structural systems the number of different elements is theoretically irrelevant. In our case 36 diverse elements have been made on two convertible apparatuses, the most common being:

Wall elements:

— gypsum surface elements (wall negatives) with periodic squares
$$21\ M \times 16\ M \times 1\frac{1}{2}\ \text{mc} = 2100 \times 1800 \times 56\ \text{mm}$$
$$21\ M \times 12\ M \times 1\frac{1}{2}\ \text{mc} = 2100 \times 1200 \times 56\ \text{mm etc.}$$

— plane gypsum elements (wall negatives)
$$21\ M \times 6\ M \times \frac{1}{2}\ \text{mc} = 2100 \times 600 \times 18{,}75\ \text{mm}$$
$$21\ M \times 3\ M \times \frac{1}{2}\ \text{mc} = 2100 \times 300 \times 18{,}75\ \text{mm etc.}$$

Floor elements:

— gypsum surface elements (floor negatives) with squares

$(18\ M—2\ \text{mc} — 2\ \text{TOL}) \times (18\ M—2\ \text{mc} — 2\ \text{TOL}) \times 1\frac{1}{2}\ \text{mc} =$

$= 1718 \times 1718 \times 56$ mm

$(18\ M—2\ \text{mc}—2\ \text{TOL}) \times (12\ M—2\ \text{mc} —2\ \text{TOL}) \times 1\frac{1}{2}\ \text{mc} =$

$= 1718 \times 1118 \times 56$ mm

Wall of cell elements:

— plane gypsum elements (wall of cell negatives)
$1800 \times 450 \times 18{,}75$ mm
$1762 \times 407 \times 18{,}75$ mm
$1725 \times 407 \times 18{,}75$ mm
$1162 \times 407 \times 18{,}75$ mm.

Functional elements

Foundations

No basement. Concrete foundation with all connections for water and heating services built in and with a system of heterogeneous jointing points for precise fastening of the alu. profiles of curtain walls.

External walls

a. *Curtain walls*

$120 \times 40 \times 1{,}5$ mm alu. tubes fastened to heterogeneous jointing points embedded into the foundation, first for holding all the structural reinforcement in precise in-situ position until concreting, and then for holding the outer "skin" composed of "glasal" plates 3,5 mm thick. The 120×1760 mm air gaps arising between glasal plates and external wall surface create summer-comfort conditions (see Figs 4 to 6).
(It should be noted here that the curtain walls may be omitted for instance in tropical or subtropical areas.)

b. *External tissue-structural wall*

External structural walls have a total thickness of $3\frac{1}{2}$ mc $= 13{,}125$ cm. The anisotropic r.c. structural tissue arises through pouring concrete into the channel system confined by, and manufactured into, the two surface elements.

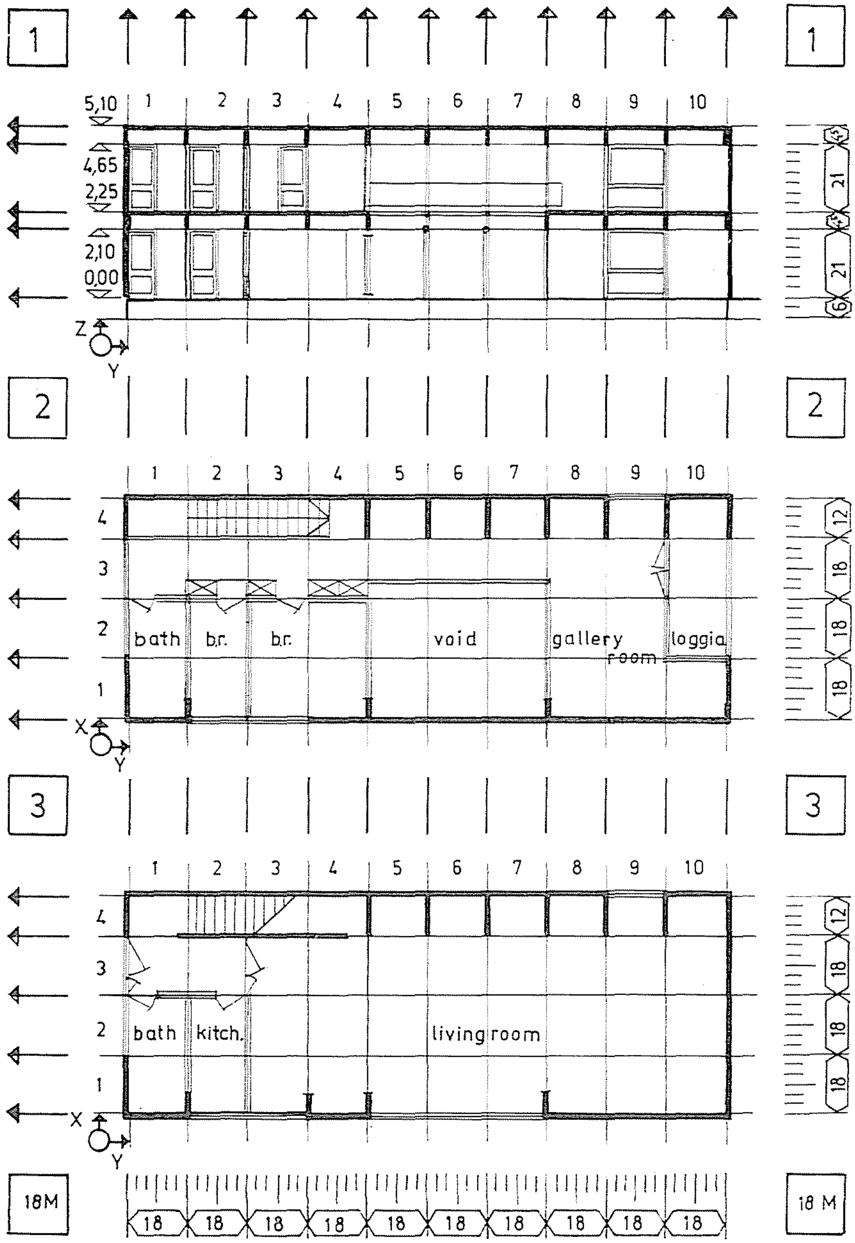


Fig. 1. The experimental maisonette unit. 1. Longitudinal section through living room; 2. Gallery-level plan; 3. Ground-floor plan

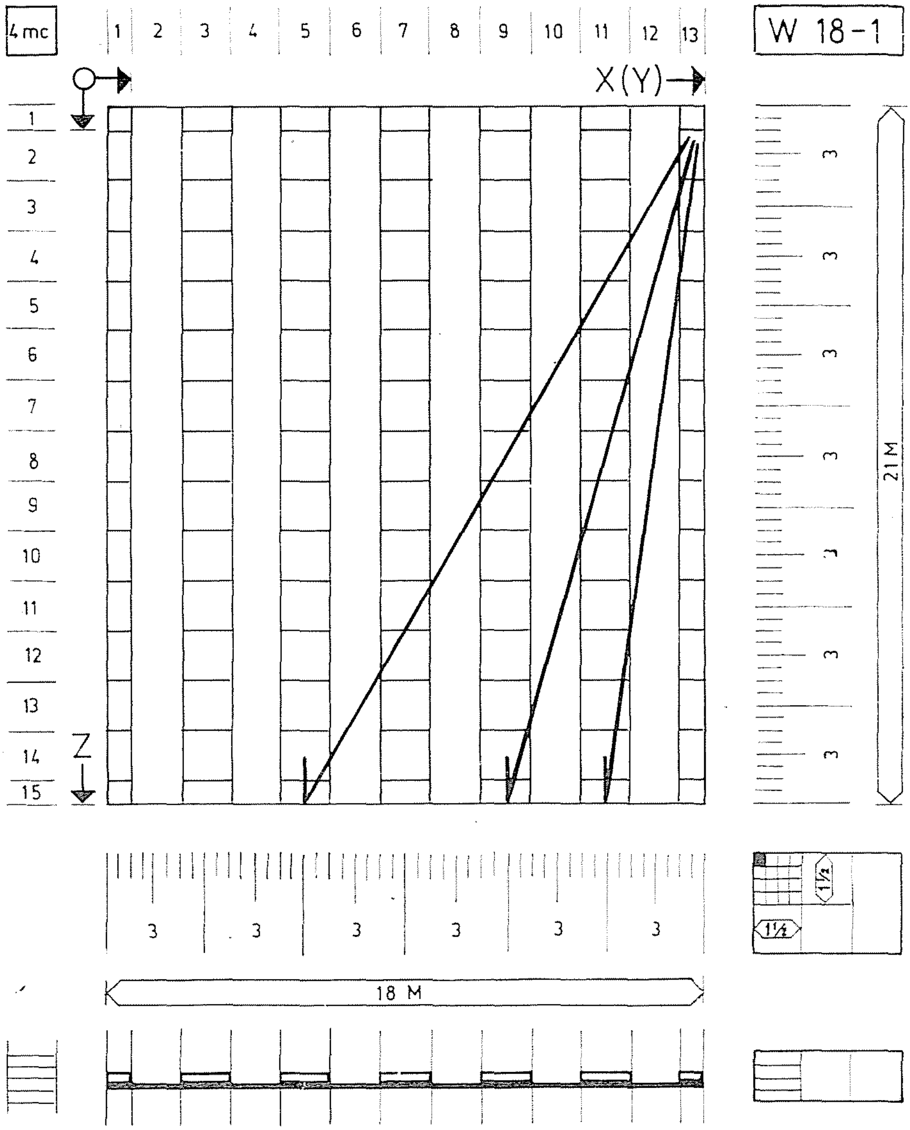


Fig. 2. Wall negative, basic gypsum surface element with periodic squares.o/a dimensions: 21 $M \times 18$ $M \times 1{,}5$ mc $= 2100 \times 1800 \times 56$ mm. The two-directional channel system fits the 4 mc$\times$4 mc = 150 nm$\times$150 mm grid. Dimension of longitudinal channel: mc$\times$4 mc = 37,5 mm $\times$ 150 mm, dimension of cross-channel: 3/4 mc$\times$4 mc = 28 mm$\times$ 150 mm

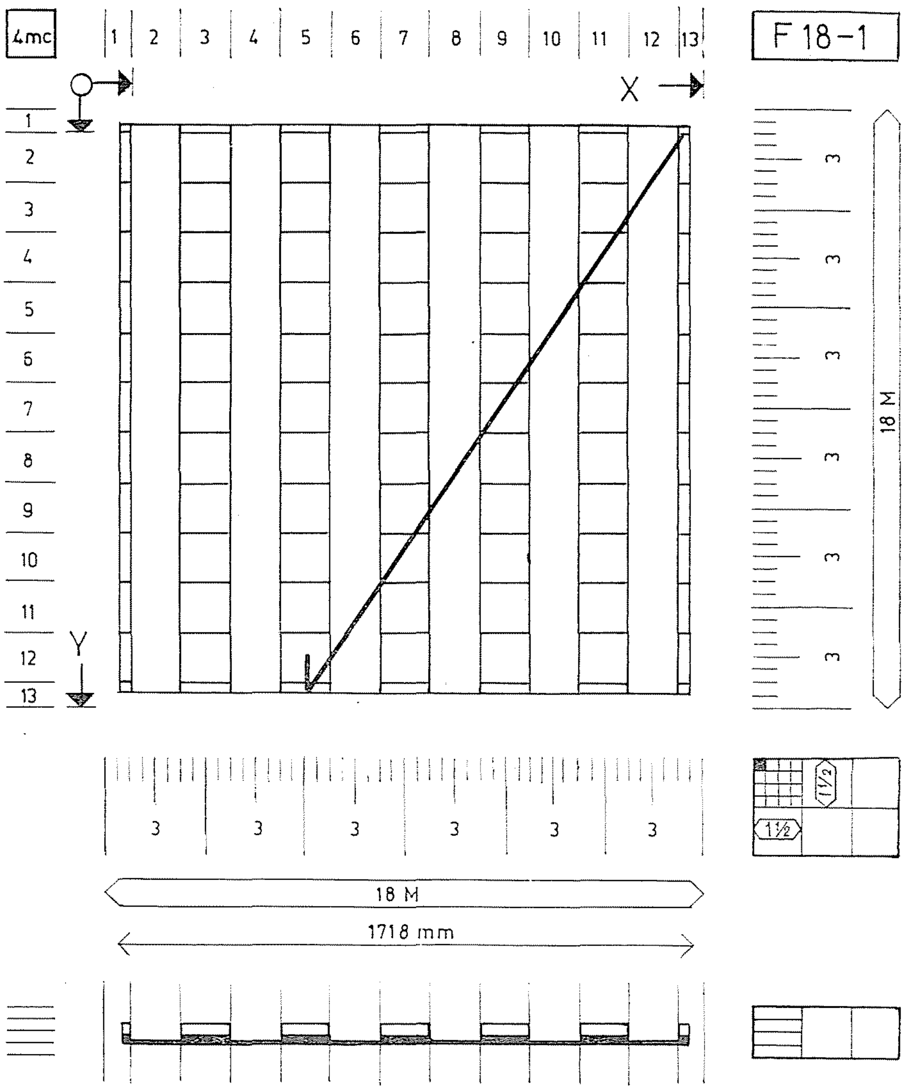


Fig. 3. Floor negative, basic gypsum surface element with periodic squares, o/a dimensions: $(18\,M-2\ \text{mc}-2\ \text{TOL})\times(18\ M-2\ \text{mc}-2\ \text{TOL})\times 1{,}5\ \text{mc} = 1718\times1718\times56$ mm. The two-way channel system fits the 4 mc$\times$4 mc = 150 mm$\times$150 mm grid

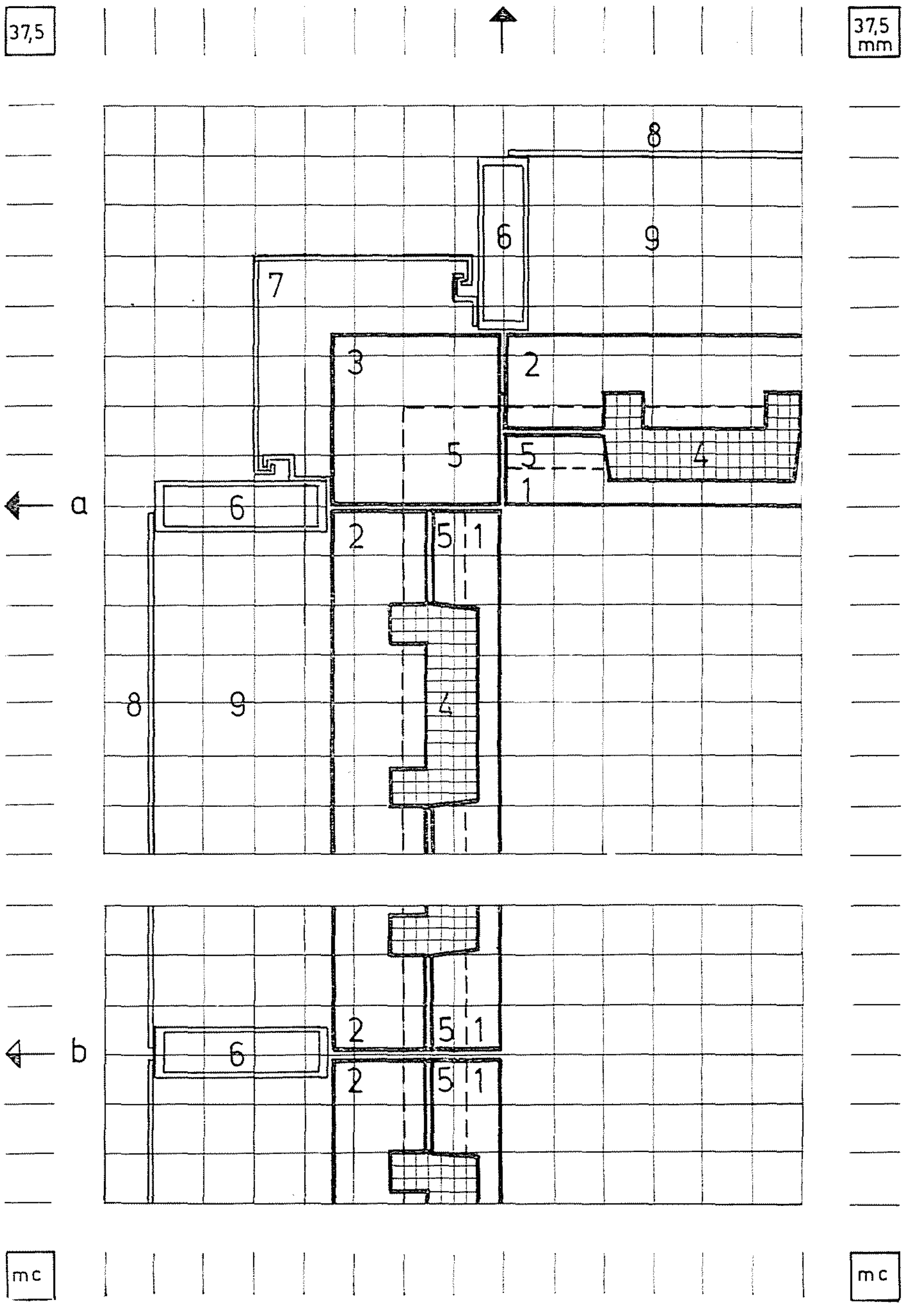


Fig. 4. Horizontal section through tissue-structural external wall and curtain wall at the corner: *a)* Microcellular detail: the location of elements in the modular and submodular grids on plan at corner; *b)* Microcellular detail: straight junction. The location of elements in the grid system on plan 1. Wall negative: basic gypsum element with squares; 2. Wall negative: basic polystyrene element with squares; 3. corner element, polystyrene; 4. vertical threads of r.c. tissue; 5. Horizontal tissue; 6. curtain wall, alu profile; 7. corner strip; 8. Glasal plates 3,5 mm thick; 9. air gap

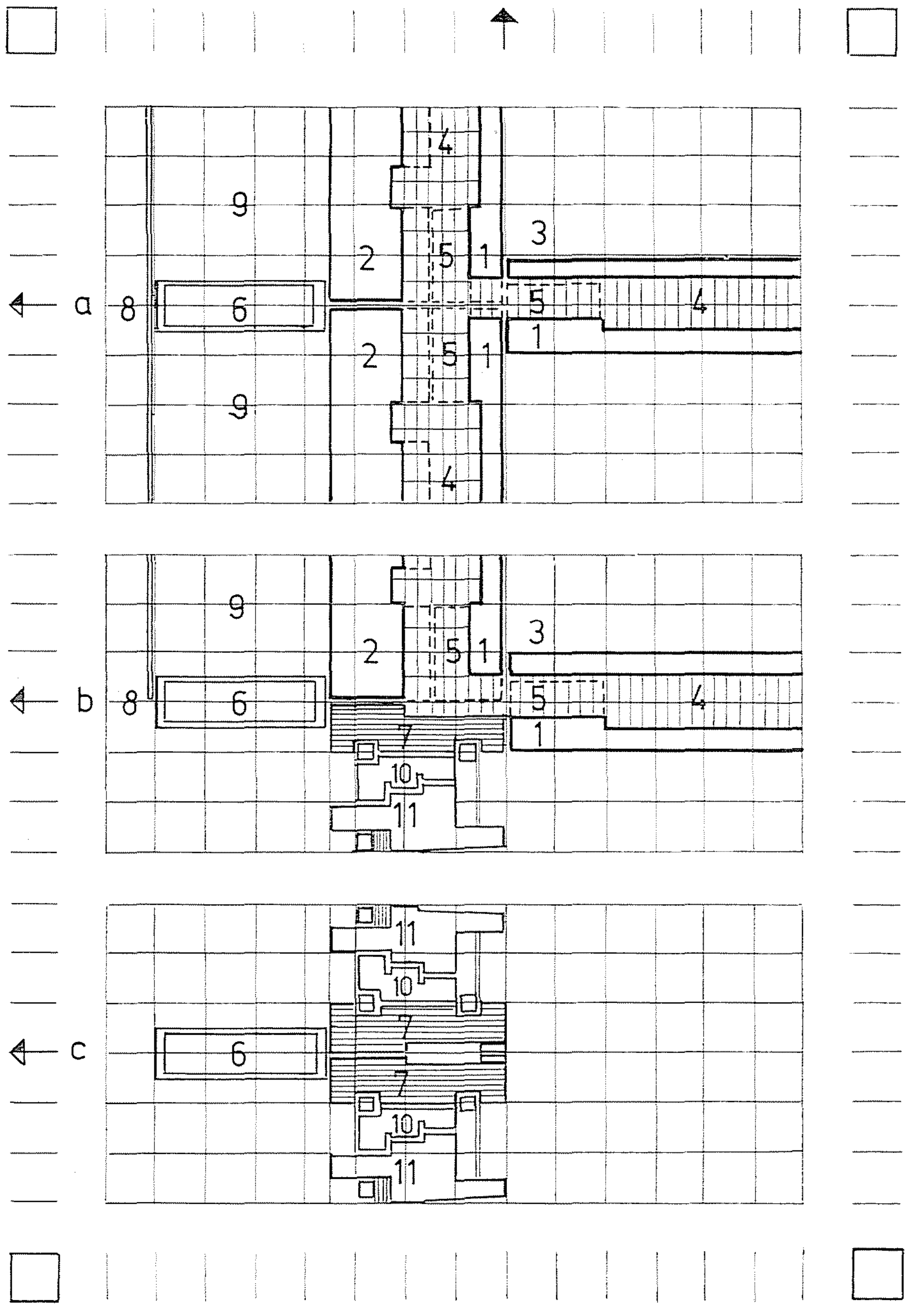


Fig. 5. a) Horizontal section through tissue-structural external wall and internal wall. Right-angle junction of r.c. threads of tissue; *b)* Horizontal section through tissue-structural external wall and internal wall. Right-angle junction of tissue and window frame; *c)* Horizontal section through external wall: straight junction of window frames. Microcellular details: The location of elements in the modular and submodular grids on plan at junction. 1. Wall negative: basic gypsum element with squares; 2. Wall negative: basic gypsum polystyrene element with squares; 3. Wall negative: basic plane gypsum element; 4. and 5. Vertical and horizontal threads of r.c. tissue; 6. Curtain wall alu. section; 7. Window frame; 8. Glasal; 9. Air gap; 10—11. Window frame and casement

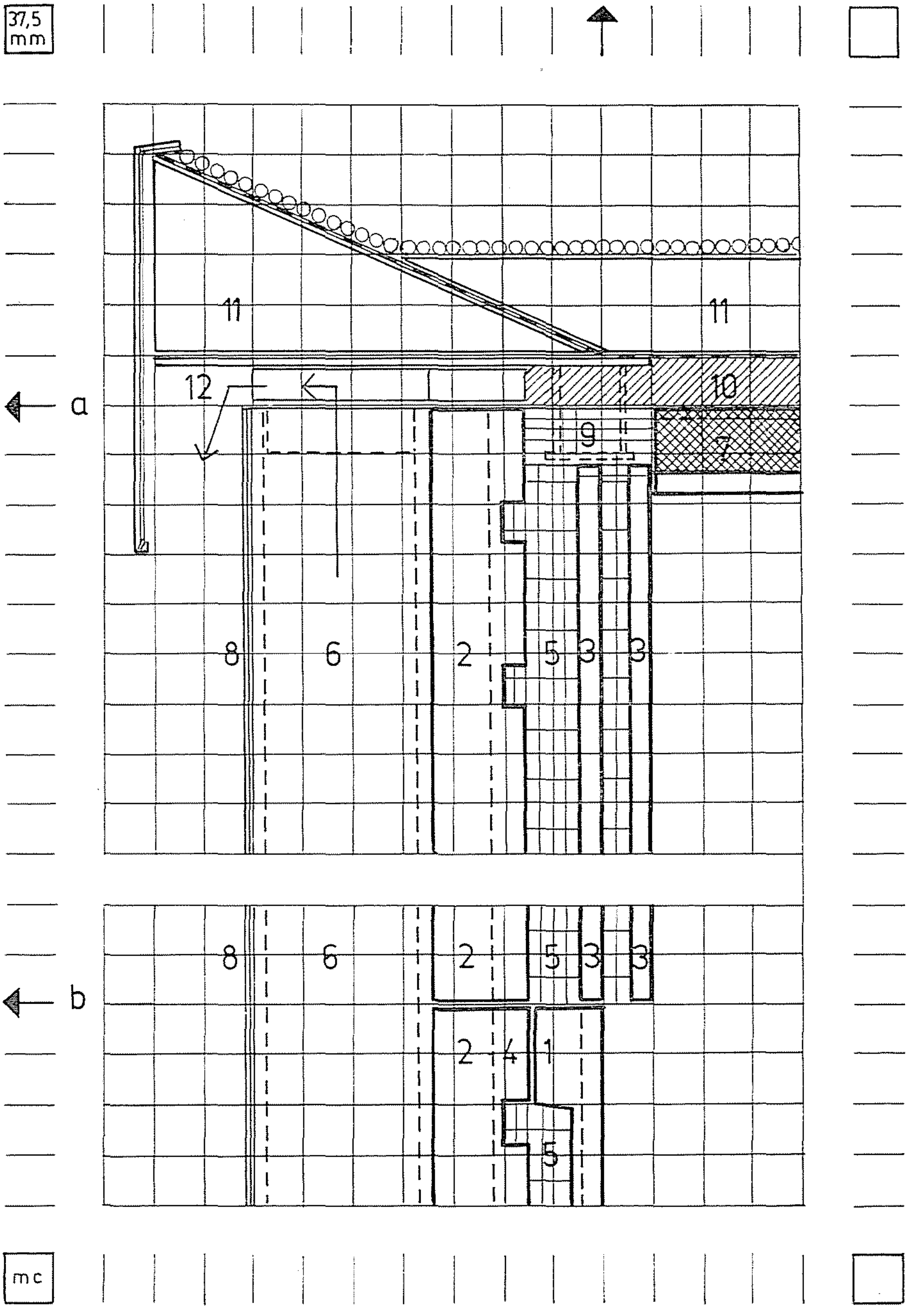


Fig. 6. Vertical section through curtain wall, tissue-structural external wall and roof floor. *a)* Microcellular detail: the location of elements in the modular and submodular grids in section at roof; *b)* Microcellular detail: Location of elements in the modular and submodular grid in section at rib of cell.1. Gypsum wall negative with squares; 2. Polystyrene wall negative with squares; 3. Plane gypsum elements; 4—5. R. c. tissue and frozen shell; 6. Air-gap; 7. R. c. tissue in floor; 8. Glasal; 9. Grout; 10. Screed 28 mm topped by dampproofing; 11. 80 mm heat insulation

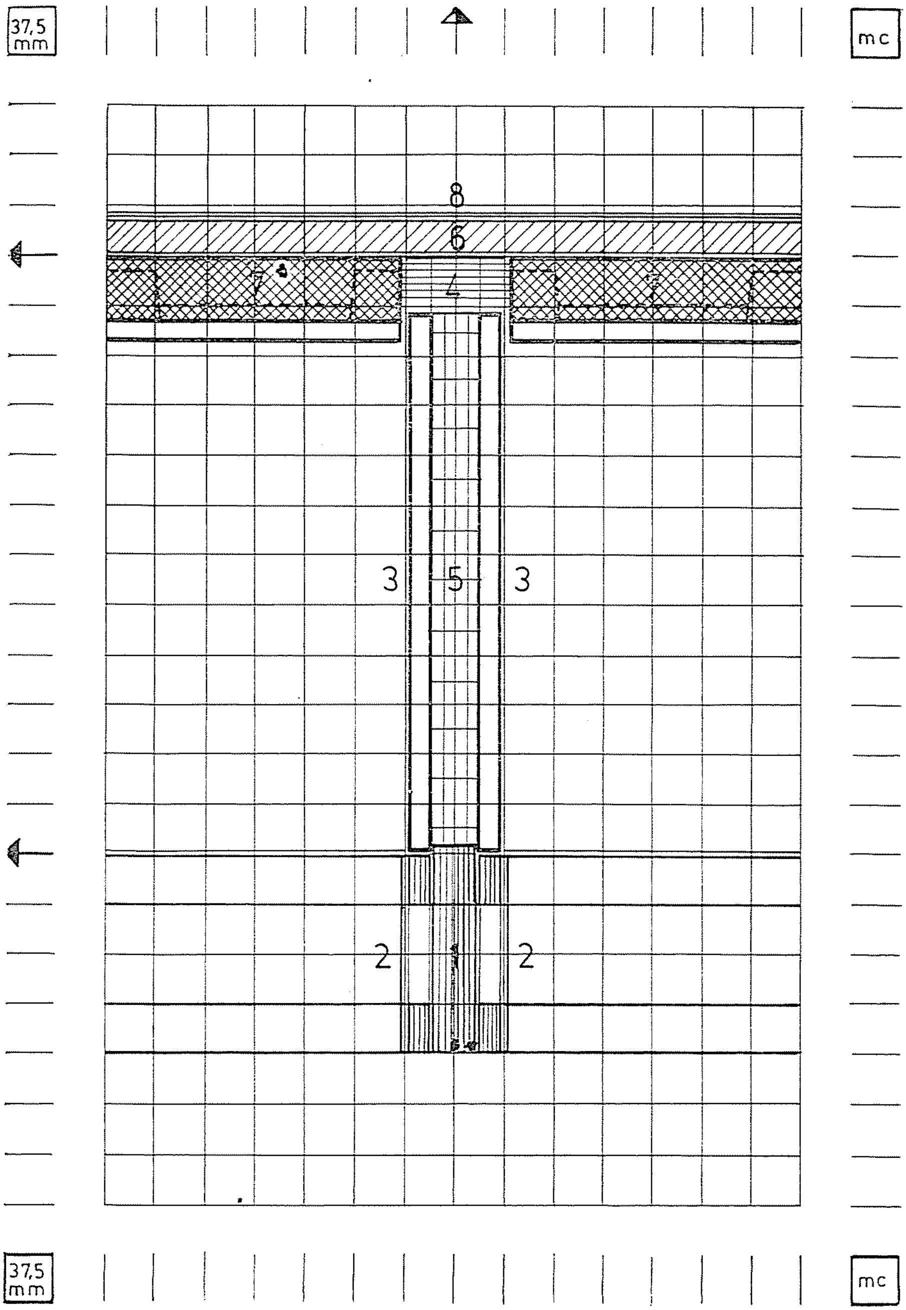


Fig. 7. Vertical section through tissue-structural floor and rib of cell at roof level. Microcellular detail: Location of elements in the modular and submodular grid in section at rib of cell. 1. Auxiliary timber structure, primary beam for supporting rib-of-cell surface elements in in-situ position until concrete is poured in; 2. Auxiliary secondary beam; 3. Plane wall-of-cell elements; 4. Grout; 5. Rib of cell, frozen shell structure; 6. Screed 28 mm; 7. Top of cell; 8. Waterproofing

The outer element is of polystyrene 2 mc = 75 mm thick, the inside element is of gypsum $1\frac{1}{2}$ mc = 56 mm thick (see Fig. 4).
Characteristic dimensions of structural tissue:
thickness of vertical thread: mc $+\frac{3}{4}$ mc = 66 mm, or mc = 37,5 mm;
thickness of horizontal thread: $\frac{3}{4}$ mc = 28 mm, or $\frac{3}{4}$ mc $+\frac{1}{2}$ mc = 47 mm.

The structural *tissue* — that is, the r.c. micro-structure stabilized within the channel system of the surface elements — appears in the form of a r.c. grid reminding of the form of tissue of woven cloth. It is always a continuous periodic microstructure, the "threads" of which fit the $3\,M\times 3\,M$ tertiary grid (see Photo 28).

Internal walls

a. *Non load-bearing partition walls;* prefabricated 75 mm thick "forgyps" partition wall panels with timber frames screwed to heterogeneous jointing points systematically embedded into the top of floor and bottom of grid. Wall-papered, washable surface. Non-load-bearing partition walls were used here to give an example of how to join manufactured partition wall structures to the r.c. tissue.

b. *Internal tissue-structural walls;* Total wall thickness: 2 mc = 75 mm. Here the structural tissue is formed between two gypsum surface elements. Thickness of vertical thread: mc = 37,5 mm. Thickness of horizontal thread: 3/4 mc = 28 mm. The threads of the r.c. microstructure fit the $3\,M\times 3\,M$ (tertiary) grid.

Floor construction, ground-floor level; Waterproofing — three layers of bitu- minous felt — is laid on a concrete layer 10 cm thick overlaying a crushed stone layer for drainage. The sealing is protected by another 10 cm layer of concrete, marking by its top the "zero-level" of co-ordination. Heterogeneous jointing points ("needles") are embedded in the top layer at 30 cm spacings, thus each vertical thread of the tissue is monolithically connected to the foundation. The tubes for district heating system and water supply are led in a built-in duct.

Cellular floor construction, first floor and roof floor levels;

a. *Rib of cell;* o/a rib thickness: 2 mc = 75 mm; height of rib: $4\frac{1}{2}$ M = 450 mm.

The rib itself is a *frozen shell* structure. In case of a frozen shell — i.e. the r.c. primary structure — the rib is formed between two plane gypsum surface elements, hence the negative of the primary structure is assembled through additivity of surface elements in the form of a two-way channel system, i.e. the cellular grid system. The frozen shell is constructed on the 18 $M \times 18$ M secondary grid (see Fig. 1).

b. *Top of cell:* R.c. tissue structure in the horizontal plane.

Total thickness of top-of-cell element:	66 mm
thickness of slab within the element:	12 mm
thickness of two-way ribs:	37,5 mm
	28,0 mm

Now, the structural tissue is formed within a horizontal channel system but its form is the same, again a continuous periodic microstructure, with horizontal threads fitting the same 3 $M \times 3$ M tertiary grid.

Floor finish: Bathrooms, kitchen, antechamber have ceramic tiles, all other rooms have full carpet flooring.

Wall finish: Kitchen and bathrooms are lined with glazed ceramic tiles. All other rooms are painted white. Non-load-bearing partition walls are wall-papered.

Joinery:

a. *Windows:* Clear, varnished larch window frames constructed on the 21 $M \times 18$ M grid;

width of frame: $3\frac{1}{2}$ mc = 131 mm

thickness of frame: mc = 37,5 mm.

Frames in non-tectonic systems are permanent auxiliary structures used first for supporting the surface elements until concreting, then, after concrete has set, they become connected to the structural tissue or frozen shell. Window sashes with thermopane glazing are mounted in the next building phase, and so are parapets with double armoured glazing.

b. *Doors:* Larch door frames are constructed on 21 $M \times 18$ M; 21 $M \times 9$ M grid. The door frames act again as auxiliary structures. Inner doors are of plywood, veneered in oak, clear lacquered, partly glazed, partly flush;

c. *Built-in cupboards:* Frames of larch, hollow plywood door 24 mm thick, veneered in clear lacquered oak.

Kitchen

Prefabricated modular kitchen units. Stainless steel sinks. Electric cooker. Refrigerator.

Staircase:	o/a length of flight	42 *M*
	floor-to-floor height	25,5 *M*
	number of risers	15
	standard rise	17 cm
	number of treads	14
	standard going	30 cm
	width of flight	12 *M*
	well of staircase	72 $M \times 12$ *M*

Domestic stair — located in the 12 *M* zone of grid system — required four cell units, that is, a 72 $M \times 12$ *M* well on first-floor level. The stair itself is a timber construction composed of treads and beam parts directly screwed to heterogeneous jointing points embedded into the structural tissue. Treads fit the tertiary grid system, sides of the flight the secondary grid system, arrangement of heterogeneous jointing points is shown on Photo 4. Timber handrail on first floor level is constructed of linear elements fastened to heterogeneous jointing points embedded into bottom of rib and top of floor.

Roofing

Waterproofing — polyisobutylene "neoacid" layer — glued on to screed on top of cell covered by 80 mm thick hard polystyrene "nikecell" layer on top of waterproofing with 30 mm gravelling. Watertight sealing of "neoacid" waterproofing layer by black enamelled alu. strips ("alwitra"). Heterogeneous jointing points to hold roofing were embedded into the edge ribs of roof floor.

Water and sanitary installations: Warm and cold water cocks in bathrooms and kitchen. In bathrooms WC's with low level cistern, lavatory basin of vitreous china and shower bath.

Electrical installation: Horizontal conduits under the roof floor cast in 28 mm screed on top of cells. Switches are embedded in gypsum between the threads of the tissue. Plug socket in all rooms, waterproof plug socket in bathrooms.

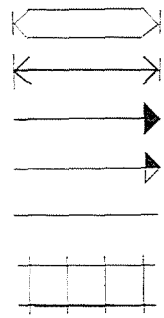
Heating: District heating from a central plant. Hot water radiators in every room at parapets and underneath the staircase.

* * *

For principles of design in non-tectonic systems let us refer to the previous publication.

The unit — the experimental maisonette —, with the location of elements in the modular (primary, secondary, tertiary) grid system on plan and in elevation is shown in Fig. 1.

Key to symbols: modular dimensions
non-modular dimensions
primary grid line
secondary grid line
tertiary grid line
micro grid line



2. Manufacture

The principle of manufacture in non-tectonic systems

Recapitulating statements in the previous paper, as opposed to any other manufactured tectonic system where the emphasis is on the manufacture of the *frame*, the non-tectonic system emphasizes the manufacture of the *surface*.

Instead of producing heavy load-bearing tectonic beams, wall and floor elements, light-weight non-load-bearing, non-tectonic surfaces for beams, walls, floors are manufactured. The surface elements are in fact finally shaped, non-load-bearing, non-tectonic bricks. Since, from an architectural points of view, the surface is always neutral, in non-tectonic systems it is practically irrelevant whether elements of wall or elements of floor are produced, the *surface being the same in either case.*

Manufacturing apparatuses

The test building has been erected from basic elements produced on three apparatuses such as:

1. Apparatus for manufacturing gypsum surface elements with periodic squares.

2. Simple timber tables with upward tilting boards — glazed pouring plates — for producing plane gypsum surface elements.

3. Apparatus for reinforcing and concreting floor elements in the factory.

All apparatuses were convertible. Gypsum elements of more than 30 different overall dimensions were produced. Both types of gypsum surface elements were used for wall and floor constructions alike. Floor negatives — i.e. top of cell elements with squares — were reinforced and concreted partly in the factory, partly in-situ.

Characteristic data of basic manufactured surface elements

a. The largest gypsum wall element with periodic squares:

o/a dimensions:	$2100 \times 1800 \times 56$	mm
volume:	0,1152	m^3
weight:	97,675	kg
manufacturing cycle:*	$40 \div 45$	min.

b. The largest gypsum floor element

o/a dimensions:	$1718 \times 1718 \times 56$	mm
volume:	0,0882	m^3
weight:	74,900	kg
manufacturing cycle:*	$30 \div 35$	min.

c. The largest plane gypsum surface element

o/a dimensions	$2100 \times 600 \times 19$	mm
volume:	0,0239	m^3
weight:	20,349	kg
manufacturing cycle:*	$10 \div 15$	min.

The process of assembling the manufacturing apparatus for wall and floor elements and the pouring in of gypsum

First, the *steel frame* is assembled, exclusively of linear component parts. The assembly of these simple and therefore easily and cheaply mass-producible steel-component parts follow the *principle of stacking* (principle of pile of logs). The legs of the frame — simple steel tubes — are all adjustable. The frame is composed of four linear beams and stiffened in precise right-angle position by disks with rectangular grooves. Next step is the location of *combs*. There are two combs — one fixed, the other removable — again linear elements which serve for the precise location of the *keys*. The teeth — that is, the periodic "grooves" in the combs — precisely determine the size and position of keys, which in turn, create a channel system in the surface (wall and floor) elements to accommodate the r. c. tissue. According to the design of the basic wall and floor elements (see Figs) the combs and keys are constructed on the "micro-grid" (grid dimension: $mc \times mc = 37{,}5$ mm). At last, the mould of the basic elements is surrounded by four plates, comprising: a *fixed comb;* movable longitudinal *side profiles* on the right and on the left-hand side; a *removable comb* at butt end. On the bottom, the mould is closed by a removable *hard vinyl* or *stainless steel pouring plate,* which — when being removed — rolls on the longitudinal beams of the frame. With the empty mould closed all

* from pouring in of gypsum to putting to storage.

four sides, *gypsum is poured* on the bottom plate until its surface reaches the top level of keys (Photo 2). 7 to 8 minutes after pouring the gypsum gets stabilized and the keys can easily be lifted by hand. Now the element is removed from the mould through rolling out the pouring plate on top of a carriage. The element overlaying the pouring plate is transported on top of this carriage to the storing place, where the element is first removed from the plate and then stored pair-wise.

3. Building

Implication of *the process of non-tectonic Gutenberg-principled building* in course of erecting the experimental maisonette is outlined below, mainly in photographs.

Gutenberg-principled non-tectonic systems are produced by a *complementary* building method, namely they combine the *factory* production of surface elements with an *in-situ* technology of pouring. Complementary building methods are particularly useful for *developing countries* in tropical or subtropical areas. Nevertheless, the *test building* was erected in *Hungary*, a country of continental climate, and in view of the completely different building physical conditions it was decided to apply a curtain-wall structure conceived as an addition to the "normal" non-tectonic structures.

In the Gutenberg-principled non-tectonic building there are two basic types of operation on the site, corresponding to the complementary character of the building method. The one is the *assembly of surface*, the other the *cycle of pouring*.

The process of non-tectonic building is exactly the opposite of the usual tectonic building. Normally, the sequence of operations starts by positioning the reinforcement on zero level, followed by the assembly of surface. In our case the additional curtain wall structure had to be erected first, followed by positioning the reinforcement on both levels and concluded by the stepwise assembly of surface-of-wall, surface-of-cell elements, as will be seen on subsequent photos.

Main data of experimental building

a) *Total floor area*		219,65	m^2
b) *External wall construction*			
gypsum	25,840 kg/m^2		
concrete	64,548 kg/m^2		
reinforcement	2,720 kg/m^2		
polystyrene foam	3,527kg/m^2		
Total	96,680 kg/m^2		
total surface:		149,94	m^2
total weight of structure:			14496,199 kg

c) *Internal wall construction*

gypsum	41,990 kg/m²		
concrete	56,719 kg/m²		
reinforcement	1,666 kg/m²		
Total	100,375 kg/m²		
total surface area:		49,77 m²	
total weight of structure:			4 995,664 kg

d) *External rib construction*

gypsum	11,640 kg/m		
concrete	29,080 kg/m		
reinforcement	1,220 kg/m		
polystyrene foam	1,610 kg/m		
Total	43,550 kg/ m		
total length:		98,40 m	
total weight:			42 85,320 kg

e) *Internal rib construction*

gypsum	14,550 kg/m		
concrete	40,500 kg/m		
reinforcement	4,000 kg/m		
Total	59,050 kg/m		
total length		246,90 m	
total weight			14 579,44 kg

f) *Floor construction*

gypsum	25,840 kg/m²		
concrete	78,680 kg/m²		
reinforcement	2,380 kg/m²		
Total	106,900kg/m²		
total area of flooring:		188,655 m²	
total weight of flooring:			20 167,22 kg

g) *Total weight of screed*	11 888,80 kg
h) *Heat insulation on roof*	375,00 kg
i) *Screed on roof*	7 720,33 kg
j) *Total weight of structure*	58 523,84 kg
k) *Total weight of building*	78 507,97 kg
l) *Weight of structure per unit area* j/a	266,40 kg
m) *Weight of building per unit area* k/a	357,40 kg

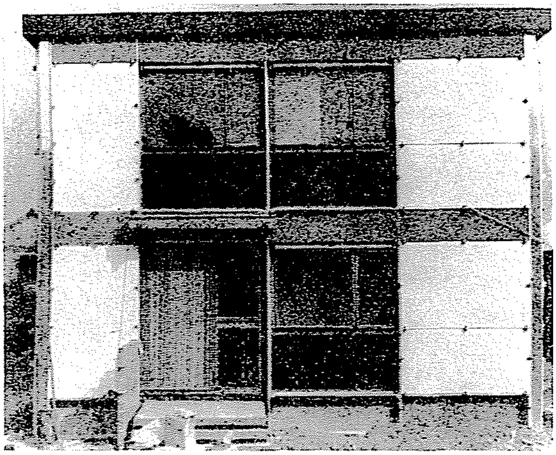
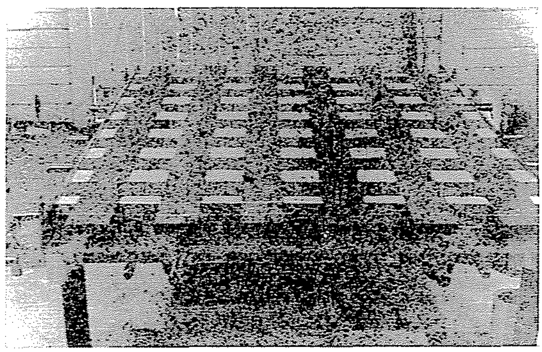


Photo 1. Entrance elevation before completion

Photo 2. Manufacturing apparatus for wall and floor elements. The apparatus produces gypsum surface elements with periodic squares. The process of assembly of apparatus — constructed only of linear elements — follows the principle of stacking. Manufacture of a 21 $M \times 18$ M wall element. Situation preceding the lifting out of keys



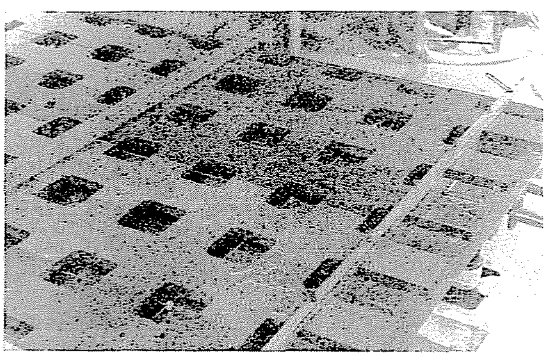


Photo 3. Manufacturing apparatus for wall and floor elements. Close view of the empty mould showing the system of keys; this is the situation before gypsum is poured in

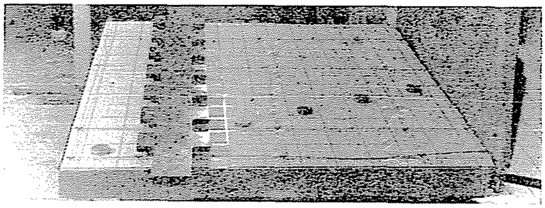


Photo 4. Training table. Simple $21M \times 18M$ timber board — actually a full-size model of the pouring plate — demonstrating the system of modular and submodular grids on the white top. It served to train unskilled workers how to locate keys, inserts, reinforcing wires, heterogeneous points in the manufacturing apparatus

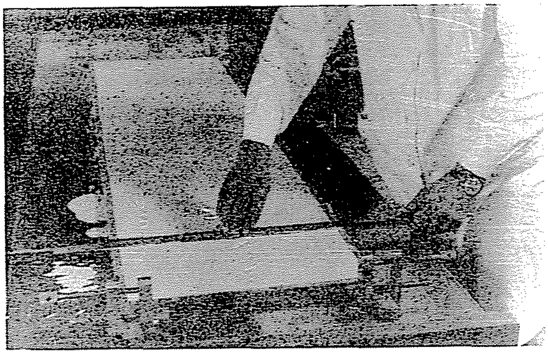


Photo 5. Apparatus for manufacturing plane gypsum elements. Timber tables with glazed, upward tilting upper boards for producing plane gypsum surface elements. Before pouring in gypsum, the overall dimensions of elements are laid out on the glass surface by assembling linear rods and U-shaped forming bars. The linear rods are scaled for all lengths, U-bars varying in width. The two linear rods and the two U-bars precisely fixed by four "parallel clampers" constitute the "mould".
Finishing a 2100×600 mm element. The final, exposed surface is facing the glass side

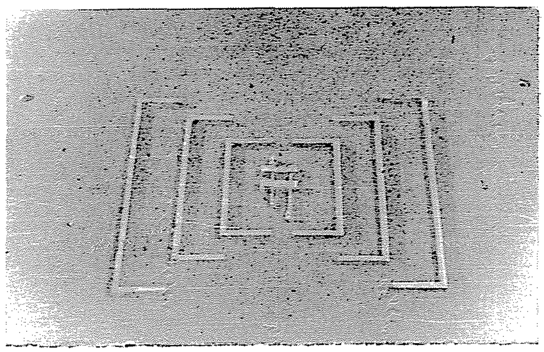


Photo 6. Series of U-bars for manufacturing plane gypsum elements. The element thickness: $1/2$ mc $= 18{,}75$ mm is of course determined by the thickness of forming bars

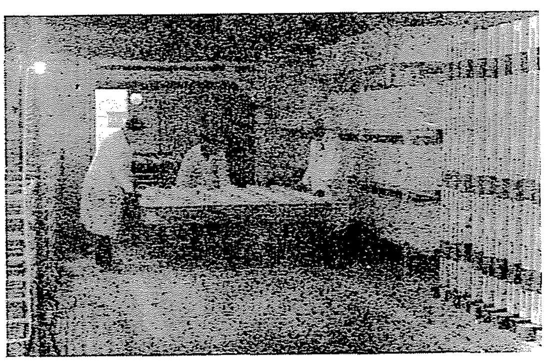


Photo 7. Storage of gypsum elements. In the background on the right-hand side the storage of plane gypsum elements is shown. Very simple, easily and cheaply mass-producible steel clips store whole sets of elements, eliminating costly storage systems. The same applies to the storage of the big 21 $M \times 18$ M wall elements with periodic squares. Carriage transports the elements from the mould to the storing place where they are removed from the pouring plate and then stored pair-wise, again reducing storage costs

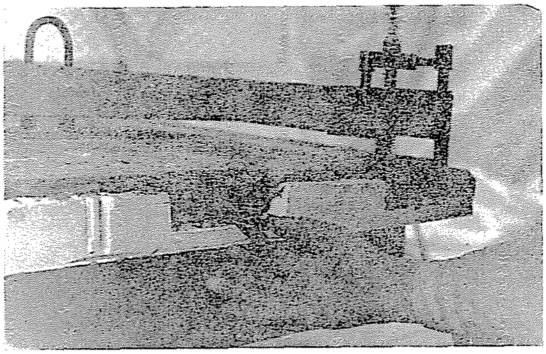
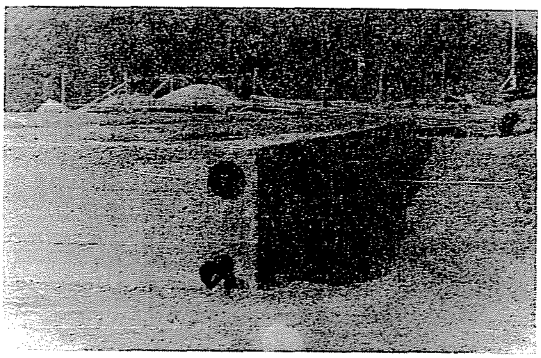


Photo 8. Handling and lifting floor elements. The completed floor element gives an excellent illustration of the structural tissue in the floor element. The tissue poured into the channels appears on all sides. The channels end in a "nose". The longitudinal reinforcing strips protrude from the concrete and — folded back — stay within the element, this is why the elements can be lifted and threaded through the ribs of the cells. The nose-ends when lifted in position exactly face the top of the beam grid. The steel needle ends are pulled out from embedded steel tubes, then the steel stripes are folded out, whereby the overall width of the element exceeds the span. Now, the reinforcement holds the unit in dry in-situ position until final structural connection is established. The auxiliary frame over the element is a tool for lifting the element from above. Forks at the end of the frame clip on to the 10 mm$\times$2 mm reinforcing stripes in the side channels. For transportation the same carriage was used as seen in Photo 8, only the top of carriage was modified to fit the overall dimensions of elements

Photo 9. Foundation. Concrete foundation: beam grid supported on eight points, with a built-in system of pair-wise heterogeneous jointing points at every 18 *M* secondary grid line serving for precisely fastening the alu. curtain walls both horizontally and vertically



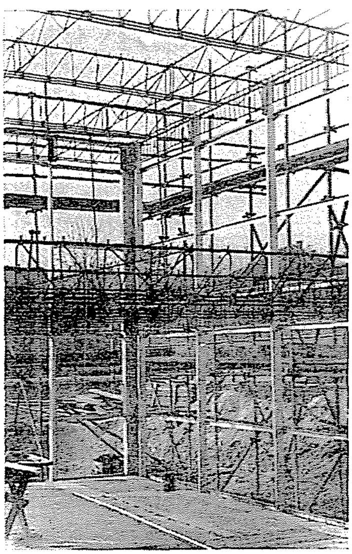


Photo 10. Erection of *curtain walls* and positioning of reinforcement on both levels

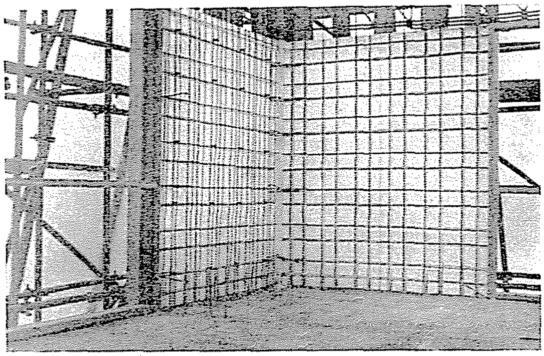


Photo 11. The process of assembly of surface: Placing outer surface elements. With curtain wall assembled and reinforcement of the two ribs screwed to alu. sections, the outer surface elements (75 mm thick polystyrene wall negatives with periodic squares) and the reinforcement of the tissue-structural external wall are placed. 15/1 mm reinforcing stripes are carried round the corners. Beyond to uniting the independent reinforcing mesh wires in a system, they lend earth-quake safety to the whole of the building since now the corners will be the strong point of structure. Window frames are screwed to heterogeneous jointing points embedded into the foundation

Photo 12. The process of assembly of surface: Placing inner surface elements. The polystyrene outer surface elements 75 mm thick with periodic squares and the gypsum inner surface elements 56 mm thick with periodic squares when put together include a two-way channel system, the negative of the tissue

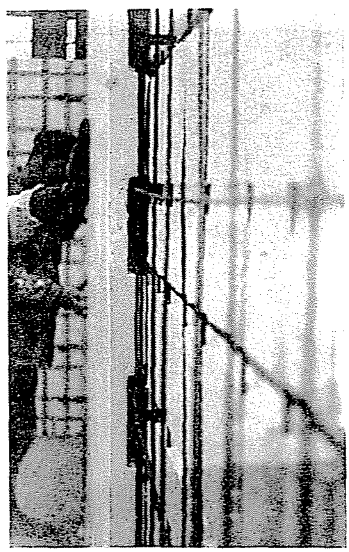


Photo 13. Process of assembly of surface: Close view of the two-way channel system, with precise manufactured reinforcing mesh closed in between

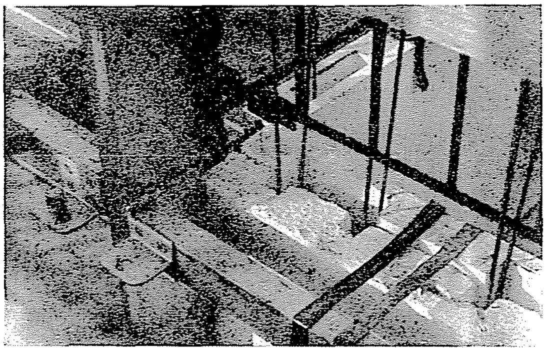


Photo 14. The process of assembly of surface: the system of tissue. Close view of the horizontal section through tissue-structural external and internal wall joining at right angle. Section through top-of-wall level exposing the system of the reinforced concrete structural tissue

Photo 15. Process of assembly of surface. Placing tissue-structural, load-bearing internal wall. Total thickness of wall: 2 mc = 75 mm; thickness of vertical thread: mc = 37,5 mm.
Internal tissue-structural walls are composed of two gypsum surface elements. With concrete poured in, the butt end of wall is closed by a linear timber frame element, which, at the same time, serves for locating of heterogeneous jointing points in the butt end of the internal wall.
Stage before concreting. The elements are kept in vertical position by direct clipping to the primary reinforcement of cellular rib above

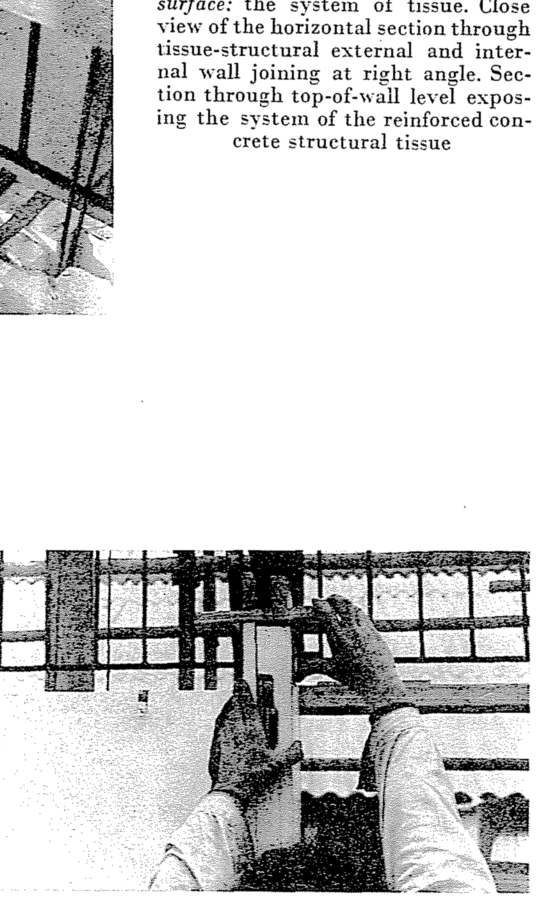


Photo 16. The process of assembly of surface. Location of internal wall. At the bottom side, wall elements were held in correct position by the same forming bars and parallel clampers which previously served for manufacturing plane gypsum elements (see Photos 5 and 6). Stage after pouring in concrete. The butt-end is closed by an auxiliary frame, necessary jointing points are already embedded into the cross threads of tissue

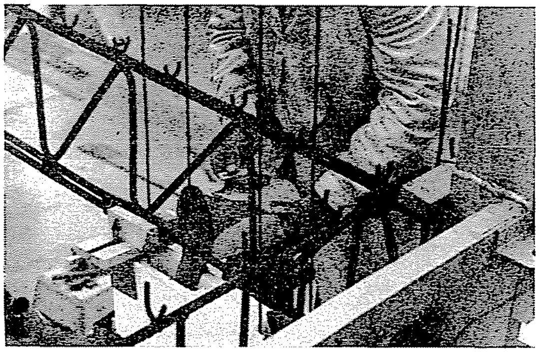


Photo 17. The cycle of pouring in the tissue of internal wall. Top view of structural detail shown in Photo 16. Elements are clipped to the reinforcement of cellular rib. Height of vertical threads: 2100 mm. Moisture absorption of the gypsum immediately stiffens the concrete poured in. The concrete freezes on the gypsum and thereby hydrostatic pressure is eliminated

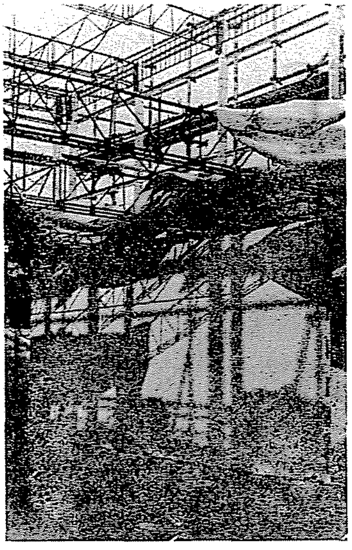


Photo 18. The cycle of pouring: Making the unstiffened wall of the staircase

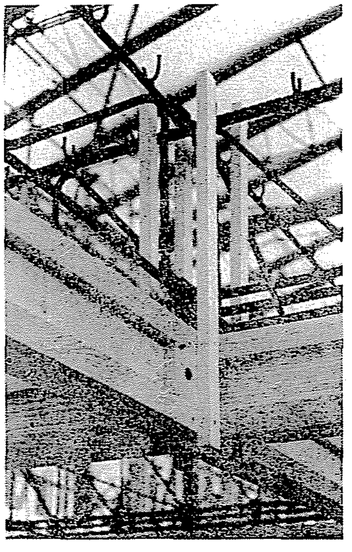


Photo 19. The process of assembly of wall of cell elements, location of the auxiliary structure for positioning of wall of cell elements.
Auxiliary timber structures serve for supporting wall of cell-surface elements in position until concreting. These regainable and many times reusable structures — necessary concomitants of every non-tectonic building — make both the process of assembly of surface and the cycle of pouring very efficient. They are always a co-ordinated system. In this case light timber beams and posts were used. Photo shows junction between primary and secondary auxiliary beam.

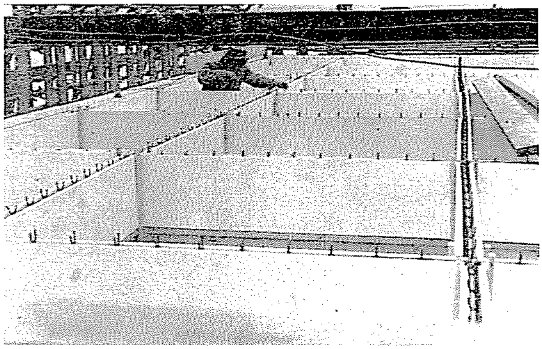


Photo 20. The process of assembly of wall-of-cell elements. Stage prior to pouring concrete into the beam grid. The plane surface elements of ribs are easy to assemble, because their "dry" position in the modular grid system is unambiguously determined by the auxiliary structure. Assembling wall-of-cell elements means to construct the *negative* of the beam grid

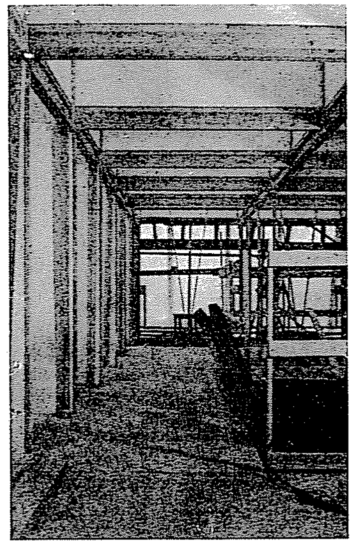


Photo 21. The cycle of concreting the beam grid. Stage following the concreting of beam grid on roof-floor level. Auxiliary beams are still in place. The surface elements of the completed beam act as "lost casing in gypsum". Elimination of hydrostatic pressure of concrete by the gypsum permits casting of deep beam grids without any costly or heavy casing

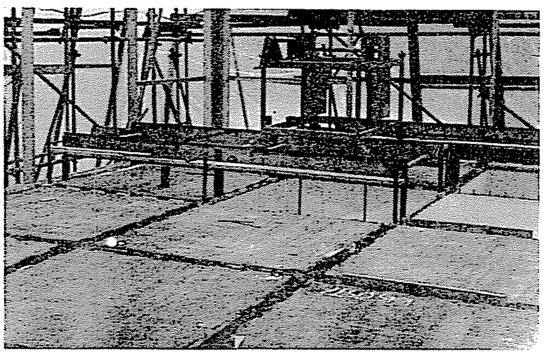


Photo 22. Location of reinforced top-of-cell elements. Connection between floor units and beam. An "18 $M\times\times 18$ M" floor unit reinforced in the factory is lifted in and threaded through the beam grid from above. When the lifted floor unit reaches in-situ position, "noses" exactly face the opposite noses on the beam top. Now the needles are pulled out and the reinforcing bands folded out (see Photo 8) to create a temporary support for the floor. Opposite needles and bands now meet above the top of beam. The noses form an open channel. Pouring concrete into this channel creates a final homogeneous joint and the structure becomes monolithic. This junction actually is a technological *translation* of welding used in steel structures into the language of r.c. tissue-structures.

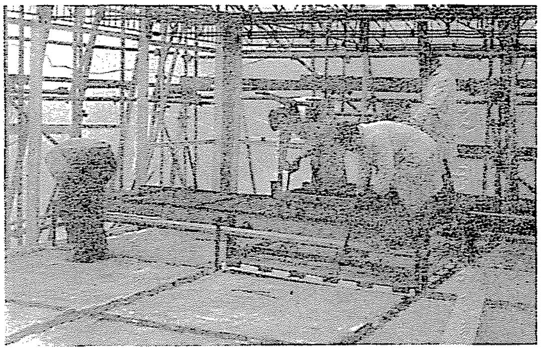


Photo 23. Location of reinforced top-of-cell elements. Folding out reinforcing stripes.
To facilitate pulling out of needles and folding out of reinforcing stripes, the element is first slightly lifted *above* top-of-beam level and then positioned

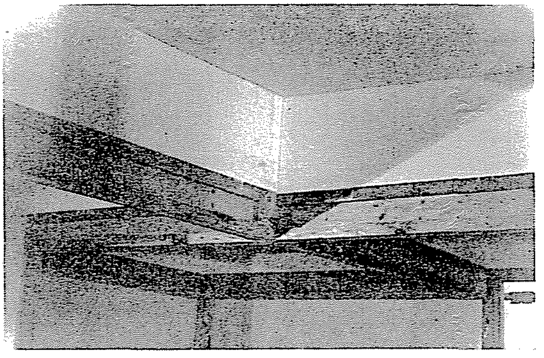


Photo 24. Location of reinforced top-of-cell element. The same stage as before, seen from below. 3 mm tolerance was given on each side of floor unit fo threading the element through the walls of the cell. Gypsum elements were found to be of reliable dimensional accuracy

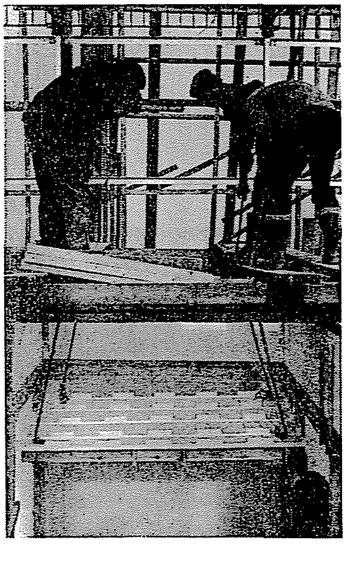


Photo 25. Erecting the test building gave an occasion to experiment with a novel technology; creating the first horizontal load-bearing tissue-structure by in-situ pouring. For this purpose a light auxiliary timber grid has been constructed on top of which the floor element was placed. Four holes were drilled into the gypsum and thereby the ropes — ending in screws — could be directly fastened to heterogeneous jointing points built into the timber grid. When the floor unit was lifted into position, little auxiliary beams were fastened underneath, to jointing points embedded into the reinforced concrete beams. In this case reinforcement is directly placed into the open two-way channels from above

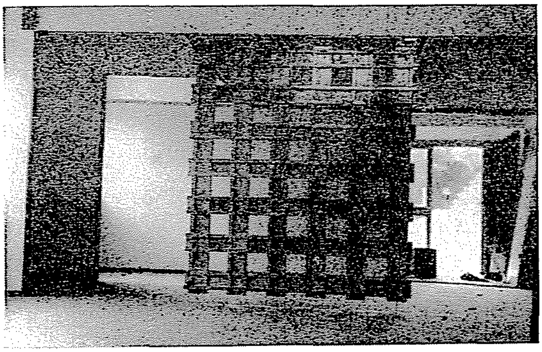


Photo 26. Timber model of the r. c. tissue. Since the load-bearing tissue always keeps hidden underneath the surface, therefore it is always a hard job to explain how tissue-structures look like, what tissue-structures actually are. This gave us the idea of producing a full-size timber model of the r.c. tissue in form of a screen wall, where all details of co-ordination and construction can immediately be seen

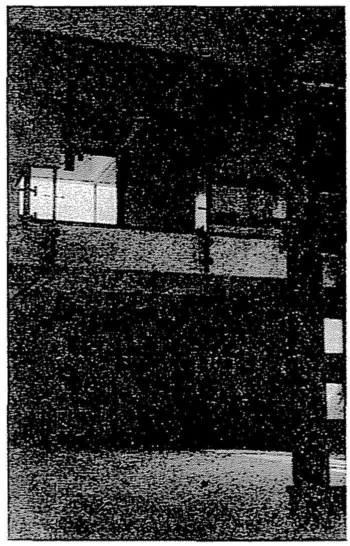


Photo 27. Interior view of the tissue-structural experimental maisonette, Budafok, Hungary, 1973. Gallery area seen from the entrance. A full-size model of the tissue is shown in the foreground. The galvanized steel posts of the railing are screwed to heterogeneous jointing points recessed into the butt-end of cantilevers or into cross-ribs of cellular floor, whereas the parapet railing — serving at the same time as furniture — is fastened to the posts, thus forming a coherent system

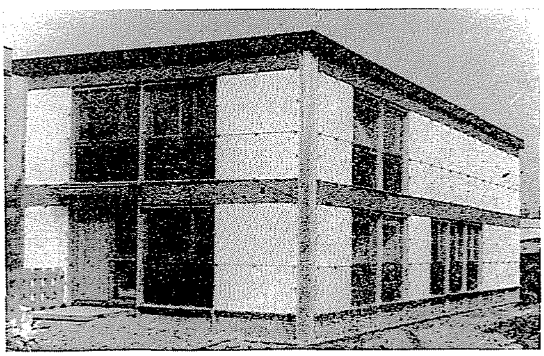


Photo 28. Experimental maisonette. Entrance and side elevation before completion. Exterior "skin" of curtain wall composed of „Glasal" plates 3,5 mm thick fastened to alu. sections without a special frame. Structural details are shown in Figs 4 to 7.

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