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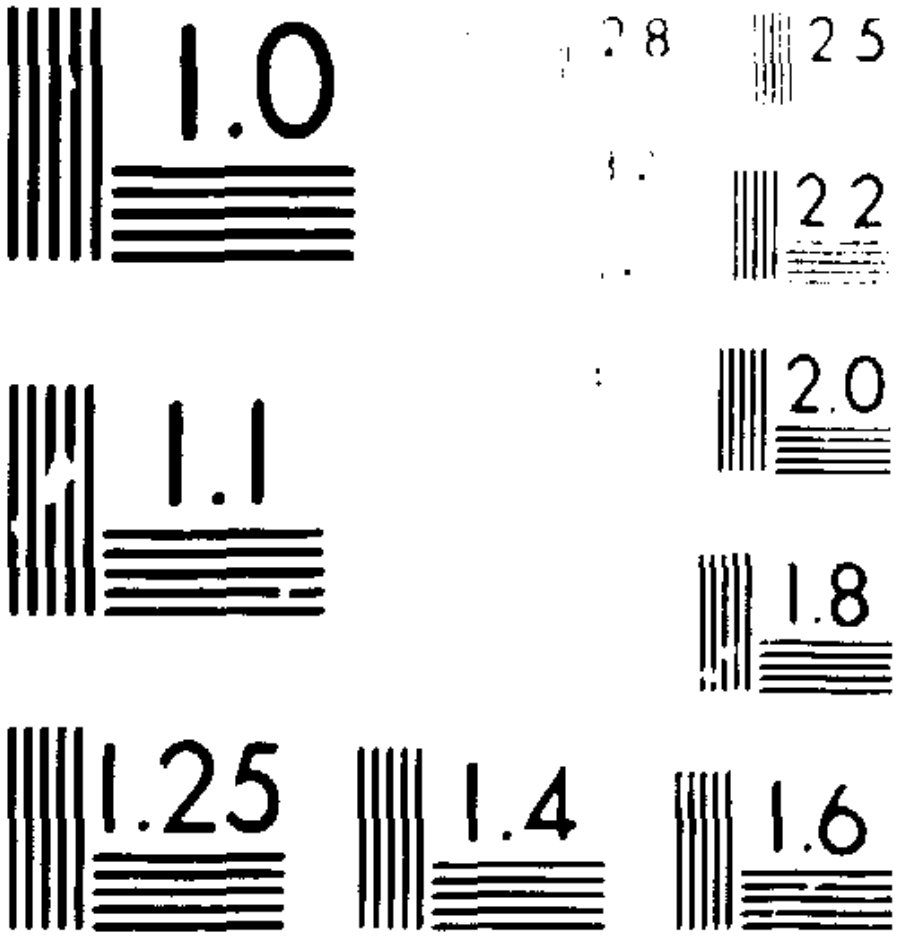
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LIMITED

ID/WG.338/11
11 May 1981

ENGLISH

United Nations Industrial Development Organization

Seminar on Economic Criteria for the Selection
of Woodworking Machinery and Plant Systems

Hannover, Federal Republic of Germany, 19 May - 2 June 1981

THE PRODUCTION AND USE OF WOODWOOL LIGHT WEIGHT BUILDING BOARDS *

by

Mr. Bory

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** Expert in the production of woodwool light weight building boards, Gebr. Canali KG.

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1. Introduction

The basic material for the production of light weight building boards is a woodwool mineral binder, using, however, only high-grade, long, fibrous, longitudinally shredded woodwool. The board structure is extremely porous and therefore its uses are many.

The most common types are the following:

- Cement-bound light weight building boards;
- Magnesite-bound light weight building boards;
- Plaster-bound light weight building boards.

2. Application

Owing to their excellent sound and thermic insulation properties, an interesting feature of these light weight building boards is their versatile applicability, mainly in the housing sector.

They can easily be machined, sawed, nailed, screwed , glued, and they also adhere easily to concrete when reinforcing is required. They are used as housing components, thermic and sound insulation elements, for any ceiling or wall, as partitions and panels, for attic storeys, flat roofs, floor padding, as well as plaster bearing elements. Besides, unplastered light weight building boards are particularly suitable for sound insulation purposes. Their use as panels for inside and outside walls, when applying the technique referred to as permanent shuttering, is steadily increasing. The coarse surface structure of these building boards ensures that the plaster adheres easily to it. They are resistant to fire, fungi, termites, and other insects as well.

From an economic point of view, then, this technique of permanent shuttering has an interesting advantage over the steel/concrete skeleton construction. Applying this technique, the steel/concrete columns and cross girders need no solid shuttering at all, which requires a lot of time. Besides this, a large quantity of shuttering boards and reinforcing steel bars can be economized, and neither are brick lining

of skeleton walls required. Since concrete shuttering works are quite easily put together, a considerable amount of labour costs will be cut out altogether. Even multi-storeyed buildings do not require any scaffolding.

3. Quality Specifications

Woodwool light weight building boards should meet a minimum of requirements according to the quality characteristics stated in the standard specifications of the DIN 1101 reading as follows:

3.1 Description of wood wool boards

Wood wool boards are light weight boards (slabs) made from wood wool and mineral binders. For the production, only sound, long-fibred and long-shreded wood wool should be used. The structure of these boards has curled wood wool and is coarse and porous.

They are mainly classified in 3 groups:

a) Cement-mixed wood wool boards
b) Magnesite-mixed wood wool boards
c) Plaster-mixed wood wool boards

3.2 Application

These light weight boards offer a varied and extensive field of application. Because of their favourable acoustical and thermic characteristics, they are mainly used in construction engineering. They can easily be worked and sawn, nailed, screwed, glued or also be mixed with concrete. The slabs are used for construction elements, for heat and sound insulation as well as for ceilings and all kinds of walls, for partition walls, wall panelling, for attics, as well as for flat roof coverings, and for floorings and plaster base. Boards are especially well suited for noise absorbtion. They are more and more used as inner and outer coatings of the so-called "shell concrete". Because of their coarse surface, a safe-sticking of the plaster is secured. These boards are equally resistant to fire, animal pests and all sorts of weeds.

"Shell Concrete"

The "shell concrete" process offers important economical advantages which complete oppose the conventional reinforced concrete process. Time consuming shuttering of the reinforced concrete columns and traverses is not necessary. Quantities of poling boards and concrete steel can be saved. Besides this, the subsequent brink liming of frame walls become unnecessary. Because of the easy construction of the shell concrete work, it is possible to operate with unskilled men. For the construction of high buildings no shuttering is needed.

3.3 Board measurements

Wood wool light weight boards are produced in standard sizes. The most commonly used size excepting those for acoustical purposes are 600 x 1800 mm and 500 x 2000 mm. The width is +/- 5 mm and tolerance in length is +5 / -10 mm. The standard thicknesses in mm are 15, 25, 35, 50, 75 and 100. The thickness deviation is limited to +3 / -2 mm. The boards must be sharp-edged and parallel in thickness and width.

3.4 Production process

For the production of wood wool boards, spruce or fir is most commonly used however pine is also used. The bolts are cut into pieces of 40 to 50 cm in length and then shredded into wood wool on wood wool shredding machines. Wood strands are moistened with a mineral agent and uniformly mixed with the binder. As mineral agent mostly calcium chloride, water glass, and other silicates are used. As binding agents, Portland cement is most often used and also magnesite and plaster.

3.5 Quality requirements

Wood wool light weight boards must meet the requirements and specifications of the DIN 1101 as listed in the table on the following page.

3.5 Cont.

Raw Weights: (kg/m^3)	Number of layers	Thickness (mm)
570	single	15
460	single	25
415	single	35
390	single	50
375	single	75
480	double	75
360	single	100
440	double	100

Bending Strength:

Board thickness (mm)	Bending strength (kg/cm^2)
15	17
25	10
35	7
50	5
75	4
100	4

Compression Strength:

Board thickness (mm)	Compression strength in per cent of actual thickness
15	-
25	15
35	18
more than 35	20

Heat Transfer Coefficient:

Board thickness (mm)			kcal/mh°
	15		-
more than	15	to	
	35		0.08
more than	35		0.07

Wood wool light weight boards must be produced parallel in surfaces and to the edges; they must be sharp-edged and have to come up to requested dimensions. The accurary of the dimensions is as follows:

Tolerance Permissable	(mm)
thickness	+3 -2
width	+5 +5
length	-10

4. Production Details

4.1 Calculation of Production Costs (Plant Size "C")

1. Material Required for the Production of 1 m3 of Building Board

Type	Board Thickness in mm	Layer Thicknesses in mm outer/Styropore/outer (face)	(core)	(face)	Woodwool in kg	Cement in kg	Styropore in m2	Mineralizing Agent CaCl2 in kg	Water ltrs.	Spray Oil ltrs.
15 a	15	5	10	-	65	120	65	3,25	195	10
25 a	25	5	20	-	40	75	40	2,00	120	10
25 b	25	5	15	5	90	145	40	4,50	180	10
35 a	35	5	30	-	30	50	30	1,50	90	10
35 b	35	5	25	5	65	100	30	3,25	195	10
50 b	50	5	40	5	45	75	20	2,25	135	10
75 b	75	7,5	60	7,5	35	55	15	1,75	105	10

2. Output

Type	15 a	25 a	25 b	35 a	35 b	50 b	75 b
Production Rate/min.	5	5	4,5	5	4,5	4,5	4,0

3. Manpower

2 skilled workers 9 unskilled workers

4. Electric Power

Approximate power input: 106 kW Approximate power output: 85 kW
(These data are to be referred to 2 woodwool machines.)

Note: All values indicated above are approximate values.

4.2 Calculation of Production Costs (Plant Size "CK")

1. **Material Required for the Production of 1 m3 of Building Board**

Board Thickness in mm	Wood in kg	Cement in kg	Mineralizing Agent $CaCl_2$ in mm	Water in ltrs.	Spray Oil in ltrs.
15	145	265	7,25	435	10
25	140	240	7,00	420	10
35	130	225	6,50	390	10
50	110	180	5,50	330	10
75	100	165	5,00	300	10

2. **Output**

Board Thickness:	15 mm	25 mm	35 mm	50 mm	75 mm
Production Rate/min.	5,0	4,0	3,5	3,0	2,5

3. **Manpower**

2 skilled workers 8 unskilled workers

4. **Electric Power**

Approximate power input: 96 kW Approximate power output: 80 kW
(These data are to be referred to 2 woodwool machines.)

Note: All values indicated above are approximate values.

5. Shell concrete details

5.1 What is shell concrete?

A decisive progression in construction engineering has been achieved in the past few years by the development of the shell concrete construction. This novel type of construction proves to be superior to the conventional construction methods so that there is no doubt of its application in the building branch any longer. The principle of the shell concrete is based on the following systems:

Bearing capacity sufficient for stories:

Minimum

Thermal insulation

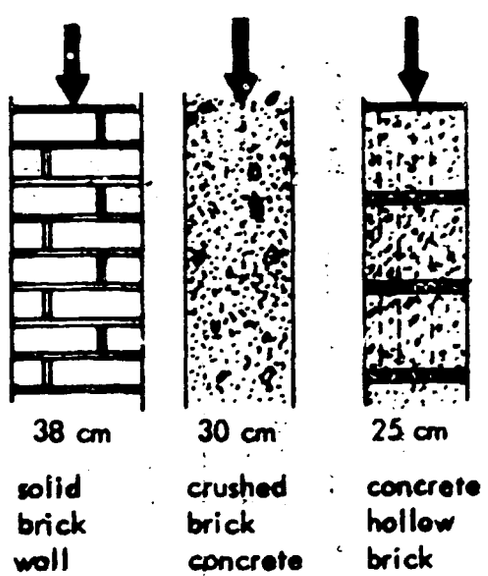


Figure 1: Single layer walls

5.2 Single layer walls

In general, the exterior walls of a house must be capable of supporting load and, in addition, they must have heat insulating properties. Since the characteristic feature of a solid building material is its great compactness and that of a heat insulating material its high poroisty, only such building materials which have limited heat insulating properties and a mean strength - such as

solid bricks, crushed brick concrete, or concrete hollow bricks are available for single layer walls. The minimum thickness of the single layer exterior wall is 25 to 38 cm.

5.3 Composite wall

The minimum insulation against heat loss required for exterior walls is already being exceeded with 5 cm board thickness when employing marked insulating materials. The loads from 2 to 4 stories must be taken with high-strength building materials, such as concrete made from natural aggregates, at a monolothic structure with 12 to 15 cm wall thickness. Therefore, the minimum thickness of the single layer exterior wall can be lowered by 40 to 50 per cent by combining highly insulating and high-strength building materials in layers. This results in considerable material and space savings.

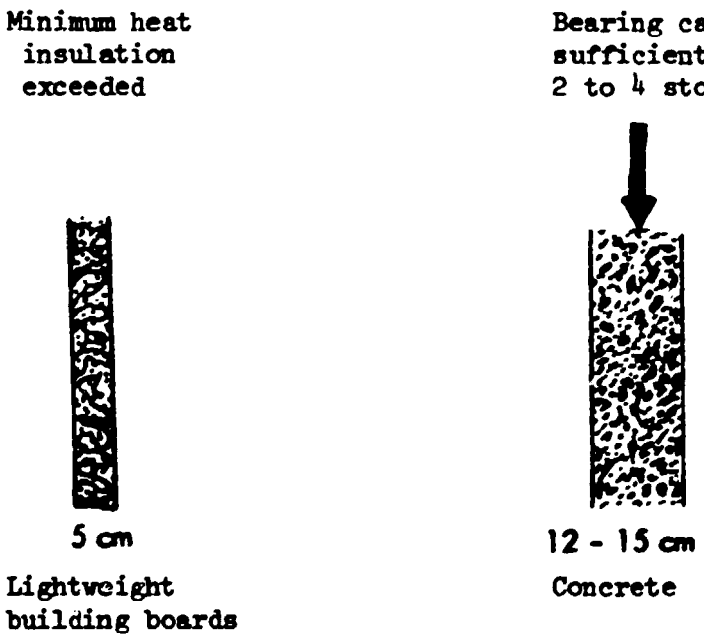


Figure 2: Material requirements of the composite wall

5.4 Shell concrete

The heat insulation of the composite wall remains unchanged if one divides the light weight building board insulating layer and sets them in pairs with each half of the board thickness. In this case, however, the two insulating boards will form a (nearly, that is) cost

free shuttering for the concrete core wall with which they will combine into a uniform structure after hardening of the lean-mixed concrete. Apart from the efficient utilization of the building materials as used, a substantial simplification of the wall construction and, thus, an optimum economy will be achieved. The two-sided firm sheathing of the concrete core wall had given rise to the term "Shell Concrete".

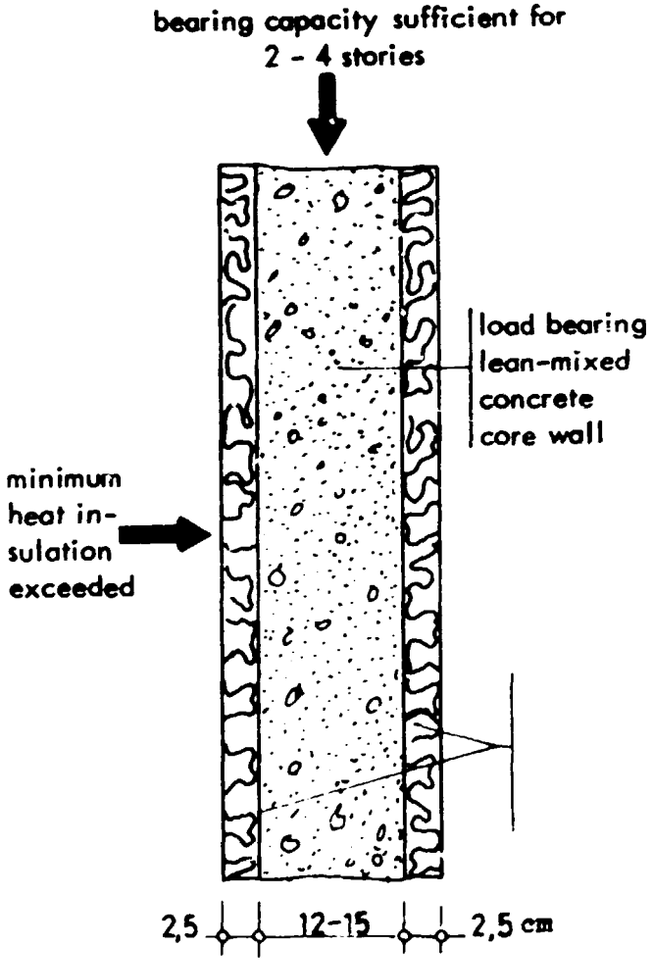
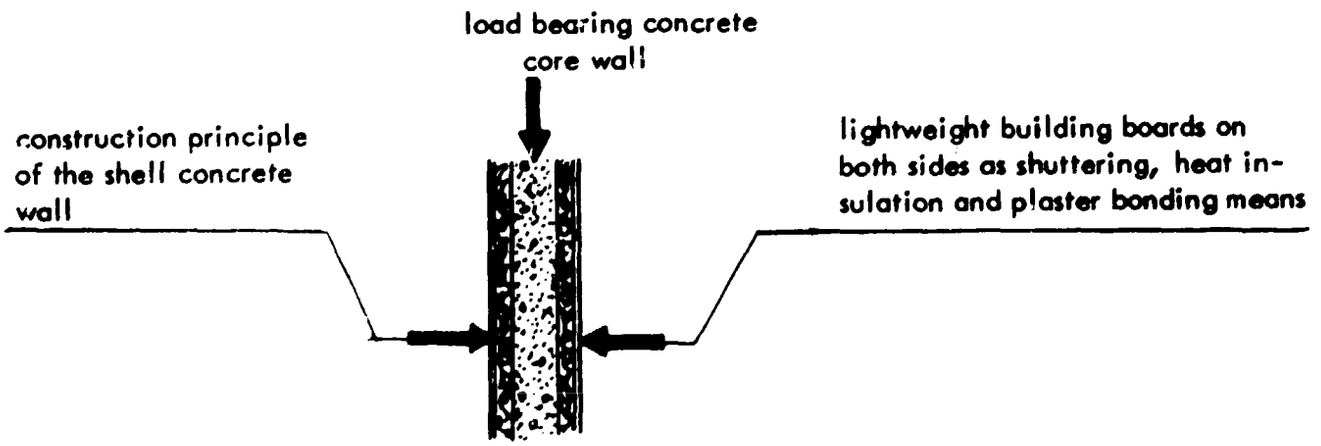


Figure 3: Shell Concrete



The modern way of construction of the load bearing and, simultaneously heat insulating wall, is the composite wall in which the load bearing wall portion is being limited to the statically required extent, and in which the duty of insulating against loss of heat is involved with the high-grade of the insulating material which guarantees an extremely high protection against loss of heat at a comparatively small thickness of layer.

The three layer shell concrete wall consisting of a monolithic lean-mixed concrete core wall made at the construction site which is firmly sheathed with light weight building boards on both sides, constitutes a particularly economic type of construction of the composite wall.

In making the concrete core wall, the light weight building boards are first al all used as shuttering which remains on the wall after hardening of the concrete and then forms a two-sided heat insulation as well as the interior and exterior plaster bonding means.

As will be noted from the comparative values, this simple wall construction proves to be technically and economically superior to the conventional types of wall construction.

5.5 Features of the shell concrete:

Bearing capacity

Ordinary concrete made from natural aggregates is used for the load bearing core of the shell concrete wall (150 to 250 kg cement/cu. m. ready-mixed concrete). Owing to the monolothic structure, the lean-mixed concrete core wall is capable of taking heavy loads with small dimensions. As for one - to two-story buildings, a core thickness of 12 cm is, in general, statically sufficient; in the case of multiple story buildings, the concrete core wall is increased in thickness by 1 to 2 cm each story. These small dimensions of the load bearing wall core enable considerable material and space savings.

Heat insulation

Heat insulation of the shell concrete wall is, substantially, effected by the light weight building boards. Two types are customary:

a) With 2 x 5, 5 cm light weight building board to meet higher requirements and for unfavourable climatic conditions. Equally insulating brick thickness = 46.7;

b) With 2 x 3, 5 cm light weight building board to meet higher requirements and for unfavourable climatic conditions. Equally insulating brick thickness = 71.0 cm.

The minimum heat insulation of a solid brick of 38 cm thickness is, therefore, being exceeded considerably (Performance Chart - item 2).

Heating-up and cooling-down

In intermittent heating operation, the shell concrete combines the advantages of rapid heating-up with those of slow cooling-down. This fact can be explained as follows: When heating is started, the inside insulating layer will prevent the penetration of the heat into the concrete core wall, and the inner wall temperature increases rapidly. Not before there is an adequate difference in temperature, the heat will get into the concrete core wall where it is stored as though in a thermos flask, since the outside insulating layer impedes the heat transfer to the cold outside air. Therefore, after having turned off heating, the wall can cool down only slowly.

In summer, however, these processes take place inversely. The short heating-up period will then enable a rapid room cooling by means of air conditions systems, and the long cooling down period will ensure a slow room heating at high outside temperatures. Consequently, the shell concrete wall is particularly qualified for achieving best housing conditions (Performance Chart, items 4 and 5).

Sound insulation

With a sound insulation figure of the shell concrete of 54 to 55 db, the

permissibleminimum value for exterior walls of 48 db is being exceeded considerably (Performance Chart, item 6).

Breathing ability

The porosity of the concrete made from natural aggregates, with a cement cc ent of 150 to 250 kg/cu.m. ready-mixed concrete, is about half that of the solid brick. For the shell concrete core wall, however, with equal bearing capacity, the required thickness is less than half that of a solid brick wall, so that the shell concrete wall has a better breaghing ability than statically equivalent solid brick masonry. In combination with the better insulation against loss of heat, a healthy housing climate is, thus, guaranteed.

Weather resistant

The absolute resistance of the plastered light weight building board to different weather conditions is generally known. Transom walls, auxiliary concrete binders and ceiling grids on the external faces, have been lined with light weight building board as the plaster bonding means for decades. The exposure of such linings, which had been subjected to the climatic effects under unfavourable climatic conditions, prooved to be without damage to the building board.

Fire resistant

According to the relevant building regulations, walls made from concrete with a minimum thickness of 10 cm and without cavities are considered fireproof. Consequently, the fire resistance is guaranteed with all types of the shell concrete.

Space saving

The small wall thickness of the shell concrete results in a considerable space saving as that compared to the solid brick style construction. Assuming the same useful area, the total volume and, thus, the room space is reduced by an average of 7 per cent in the case of the closed method of construction and by up to 15 per cent in the case of the open method of construction.

6. Field of application

By the separation of static and thermic functions, the shell concrete wall will be suitable for dwellings and commercial buildings of all types and sizes. The shell concrete wall is composed of ordinary gravel sand with about 85 per cent in weight, which can always be procured on the shortest way of transportation. The excavated gravel, too, may be used in many cases. The light weight building boards and the small amount of cement required constitutes a very small weight proportion of the wall with about 15 per cent. Thus, the transport problem is solved in a unique way, and shell concrete buildings can be efficiently set up everywhere. The light weight building board/concrete hollow brick procedure requires no framework or expensive scaffoldings whatsoever and can, therefore, be applied to small-scale and large-scale sites with no difficulity,

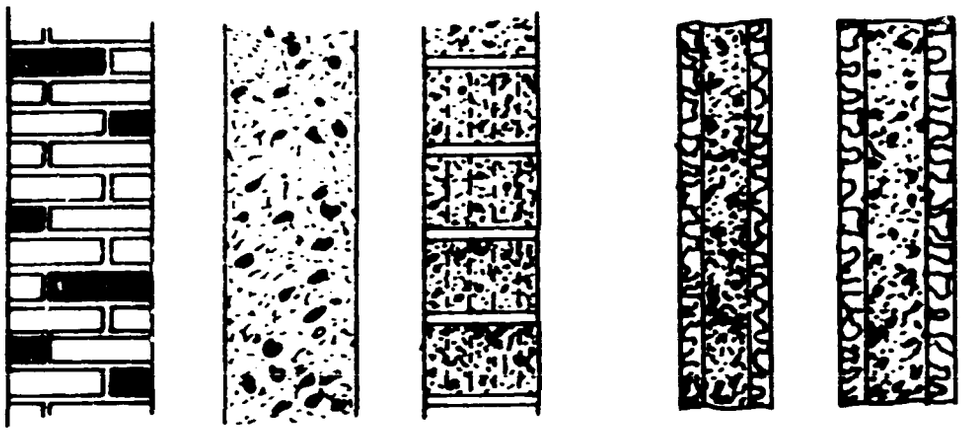
7. Construction costs

Notwithstanding the quality properties achieved, the shell concrete style of construction is the cheapest of the solid types of construction known to date.

The wall construction costs are reduced by about 40 per cent, as compared with the 38 cm standard brick wall. Due to the reduced wall thickness, however, the dead weight of the wall is lessened and, in addition, the building area is reduced with equal useful ar This results in further savings, such as less earth excavation, reduced dimensions of the foundations and basement walls, smaller adweasurement of the roof truss and of the roof covering, less plumbing work required, etc. Considering these additional savings, the shell concrete wall can be constructed about 50 per cent cheaper than the standard brick wall of 38 mm thick. Apart from the reduction of the construction costs, the regular saving of the heating costs must also be taken into consideration.

ANNEX 1

Performance Chart of Different Types of Wall Constructions.
(a comparison of the different types)

item	type of wall construction	 solid brick	crushed brick concrete	concrete hollow brick	shell concrete 2.5/12/2.5	shell concrete 3.5/12/3.5
1	wall thickness (cm)	38.0	30.0	25.0	17.0	19.0
2	equally insulating brick ceiling	38.0	37.5	37.8	46.7	71.0
3	relative heating-up period (h)	9.9	6.5	3.9	4.3	3.8
4	relative cooling-down period (h)	29.0	18.6	11.2	17.6	28.6
5	Sound insulation figure (db)	56	52	49	54	55

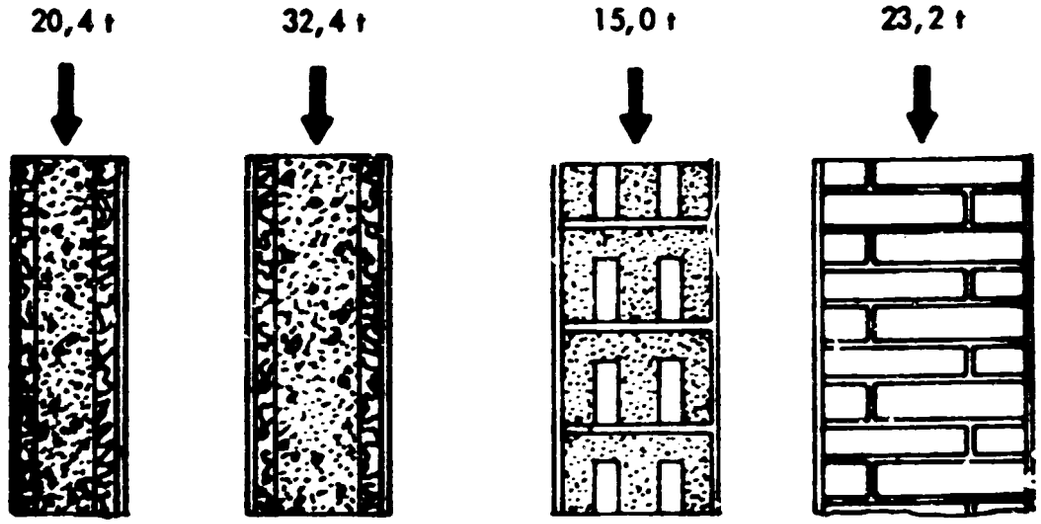
ANNEX 2/1

Constructional Characteristics

High Strength

The load bearing concrete core of the shell concrete wall is finished without joints and is, therefore, capable of taking heavy loads with small dimensions.

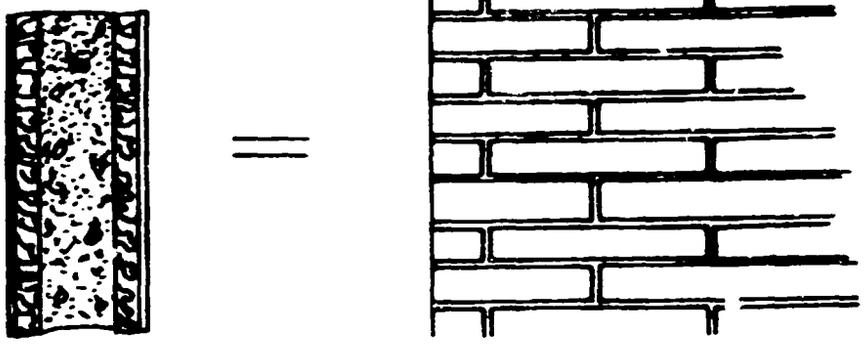
Permissible loading for 1 m width of pillar at 3 m story height



Optimum Protection Against Loss of Heat

The two-sided light weight building board insulation guarantees optimum protection against loss of heat which, according to the thickness of the light weight building board, equals a solid brick wall of 50 to 100 cm thickness. (as seen on the following page).

ANNEX 2/2



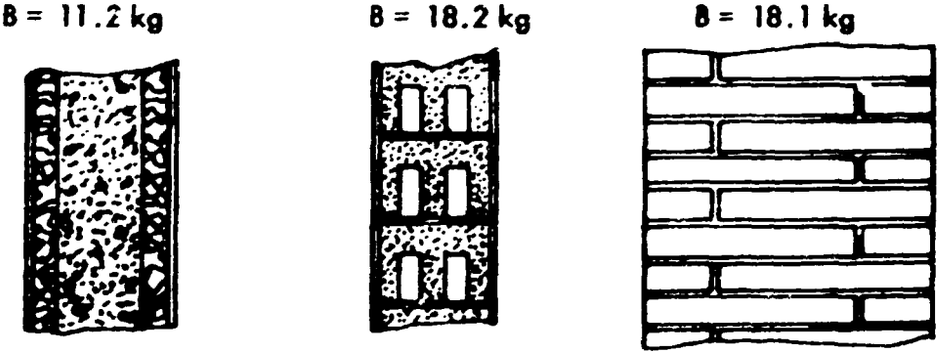
13 cm concrete core
+ 2 x 3,5 cm Heraklith

= 74 cm
equally insulating brick ceiling

Permanent Fuel Saving

Due to the optimum protection against loss of heat, a permanent fuel economy is being achieved, i.e. about 7 kg of coke each sq. m. wall and year in the case of the 3.5/12/3.5 cm shell concrete wall, as against exterior walls with minimum insulation against loss of heat.

Annual fuel requirements in kg coke per sq. m. exterior wall



B = 11.2 kg
3.5/12/3.5 cm
shell concrete

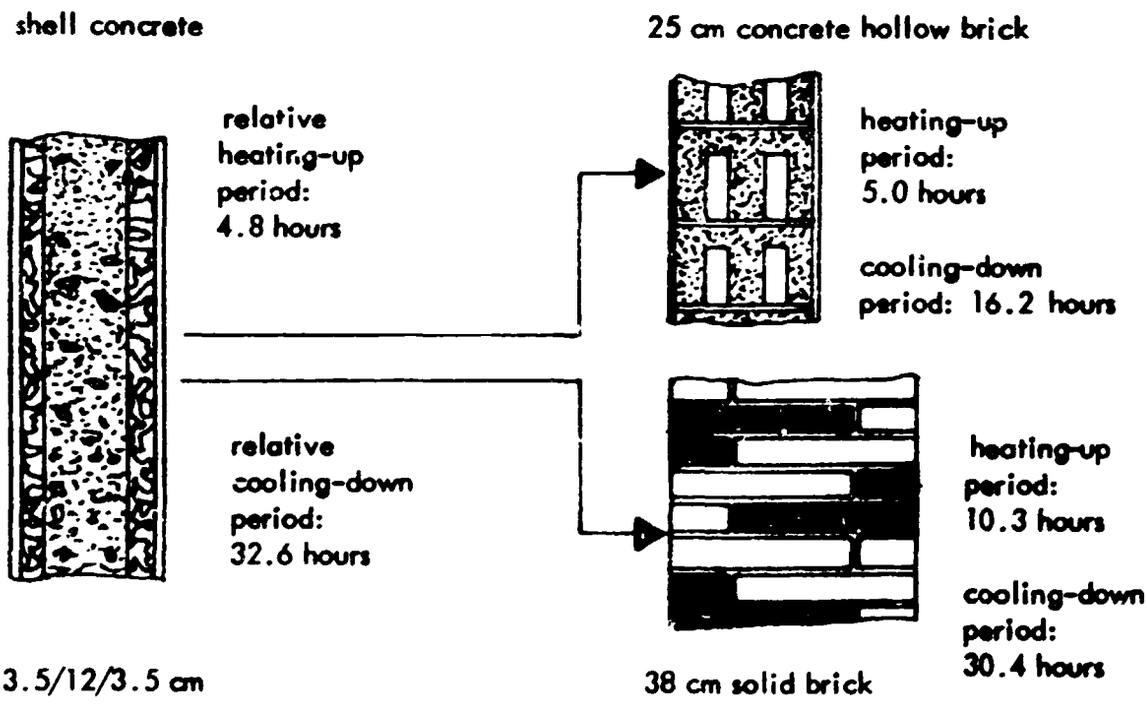
B = 18.2 kg
25 cm
concrete hollow
brick

B = 18.1 kg
38 cm
solid brick

ANNEX 2/3

Rapid Heating-Up and Slow Cooling-Down

Ancther advantage of the two-sided light weight building board insulation of the solid wall core is the short heating-up period and log cooling-down period of the shell concrete wall.

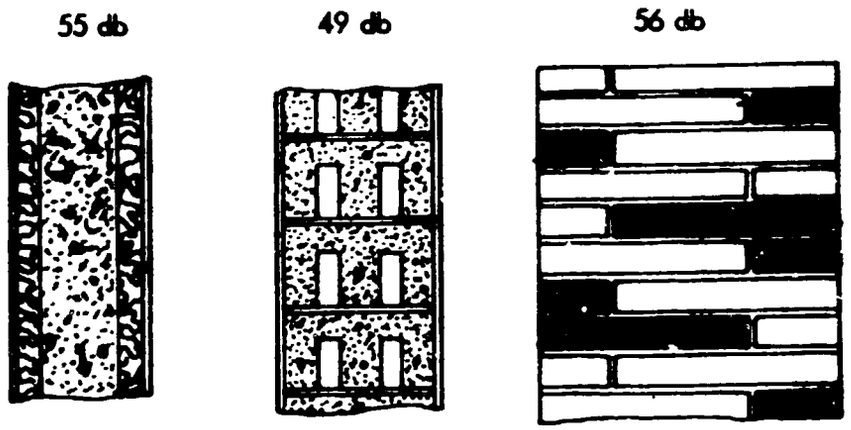


ANNEX 2/4

Good Sound Insulation

With a mean sound insulation figure of the shell concrete wall of 55 db, the permissible minimum value for exterior walls of 48 db is being exceeded considerably.

Sound insulation figure including plaster



Law Material Consumption

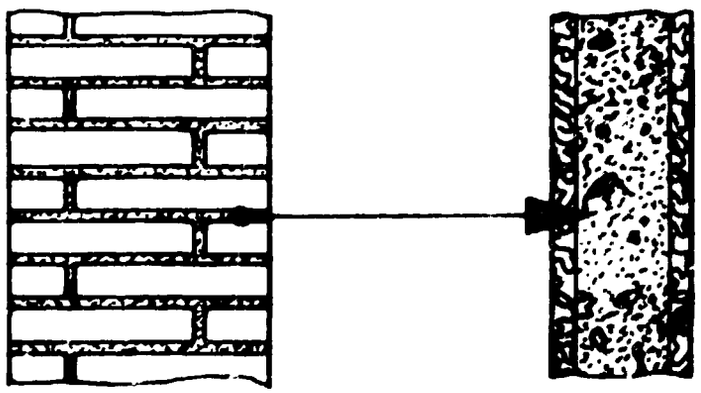
The amount of lean-mixed concrete required for shell concrete walls is so small that, for instance, with 12 cm core thickness, it corresponds to the mere mortar expenditure of the 38 cm solid brick wall.

Joint mortar

0.12 cu.m. per sq.m. wall

Lean-mixed concrete

0.12 cu.m. per sq.m. wall

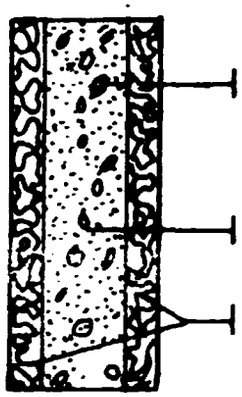


ANNEX 2/5

Ease of Material Procurement

The material requirements of the shell concrete wall which, in themselves, are low, are constituted by ordinary gravel sand by about 83 per cent in weight which can always be procured on the shortest way of transportation. In many cases, it is also possible to use excavated gravel.

Material expenditure of the 3.5/12/3.5 cm shell concrete wall



250 kg gravel sand = 83 % in weight

20 kg cement = 7 % in weight

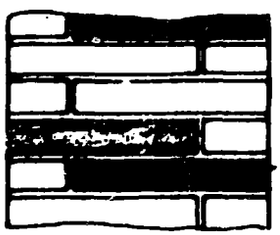
30 kg lightweight building board = 10 % in weight

Rapid Progress of Work

The large sized shutter elements of light weight building boards enables the particularly rapid set-up of the shell concrete wall.

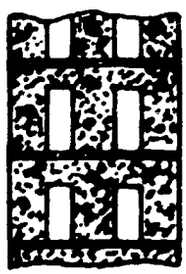
The following is required for setting up 1 square meter wall surface:

151 Nos. Standard brick



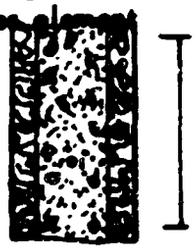
38 cm solid bricks

17 Nos. Concrete hollow bricks



25 cm concrete hollow bricks

1 No. lightweight building board shutter element



e.g. 19 cm shell concrete

Low Construction Costs

Despite the quality properties achieved, the shell concrete type of construction is the cheapest of the hiterto known solid types of constructions, let alone the cost of wall construction.

Furthermore, due to the small wall thickness of the shell concrete, the total volume and the room round of the building are reduced with an equal useful area. This results in further savings, such as less earth

ANNEX 2/6

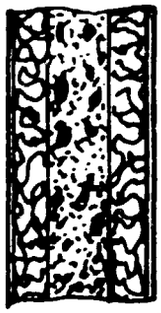
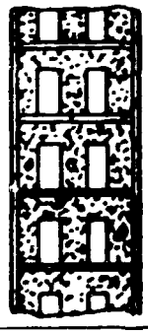
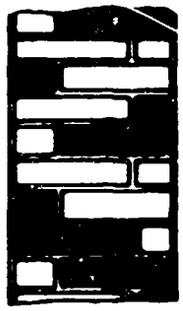
excavation, reduced dimensions of the foundations and basement walls, smaller admeasurement of the roof truss including roof covering, etc. (See sketches I, II, III and IV).

Finally, the excellent insulation of the shell concrete wall against loss of heat must be considered since, in addition to the permanent fuel economy, it enables the employment of a smaller heating installation.

When summarized, the following comparative values are obtained for the different types of construction of the shell concrete with 2 x 2.5 cm, 2 x 3.5 cm and 2 x 5 cm light weight building boards, as against the conventional types of wall construction:

Performance Chart of Different Types of Wall Construction (comparison of wall characteristics).

All walls with 1.5 cm internal rendering, and 2.0 cm external rendering.

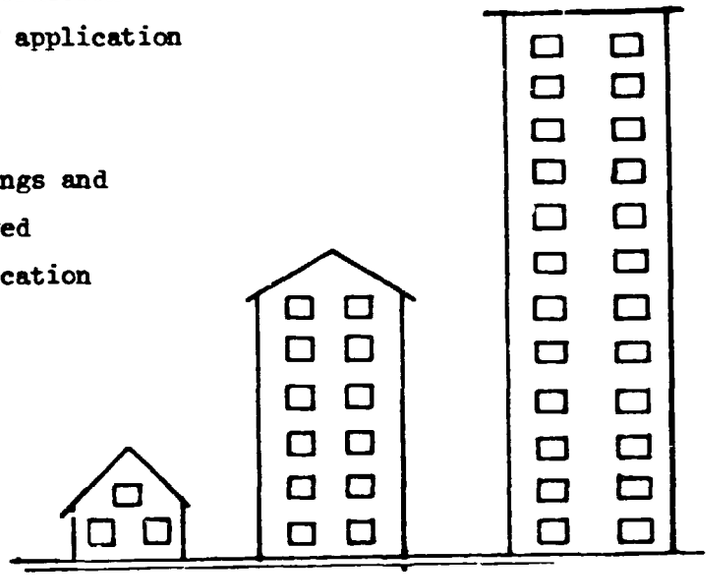
Wall Characteristics	Shell concrete with 12.0 cm concrete core lightweight building board			Hollow brick	Solid brick
	2 x 2.5 cm	2 x 3.5 cm	2 x 5.0 cm	25.0 cm	38.0
					
wall thickness including rendering (cm)	20.5	22.5	25.5	28.5	41.5
equally insulating brick thickness dz (cm)	49.6	74.0	102.0	40.8	41.0
Annual fuel requirements (kg coke per sq.m. exterior wall)	15.6	11.2	8.5	18.2	18.1
Relative heating-up period (h)	5.2	4.8	4.8	5.0	10.3
sound insulation figure (db)	54	55	56	49	56
Relative cooling-down period (h)	23.1	32.6	52.8	16.2	30.4

ANNEX 3/1

Constructional advantages

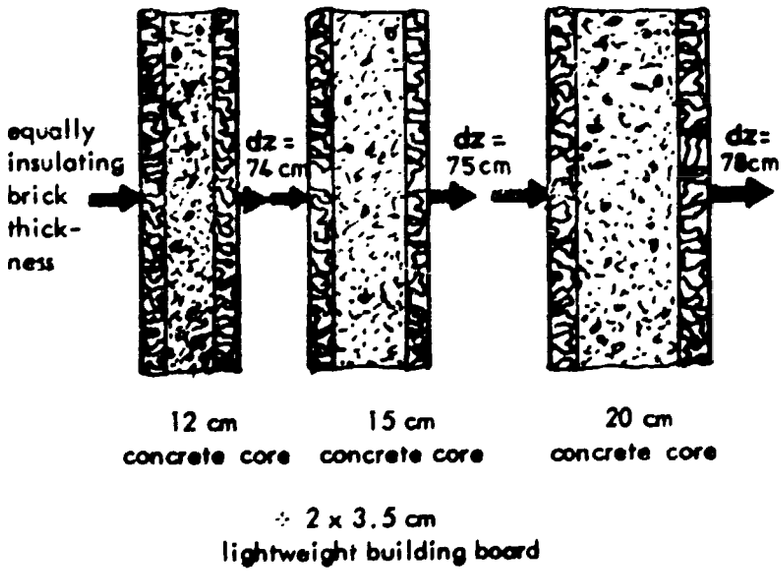
Universal applicability

The conventional types of wall construction are suitable for a limited field of application i.e. hollow brickwork for single to double story buildings. solid brickwork for multiple story buildings and skeleton structures for high storeyed tall buildings. An extensive application of these types of constructions is impossible on an exonomic basis.



The shell concrete wall, however, can be accurately dimensioned for any case of loading, irrespective of the particular insulation against loss of heat desired, as a result of the separation of the static and thermic functions. Thus, the economy of the shell concrete type of construction is given in like manner for all home and commercial buildings.

The universal applicability of the shell concrete type of construction, which could not be achieved with any other construction system to date, enables an extensive rationalization of construction operations.



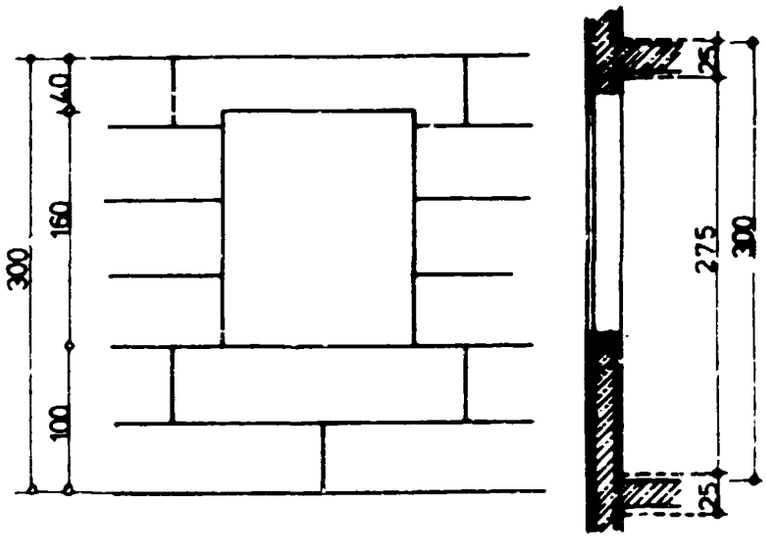
ANNEX 3/2

Simple Shuttering Principle

The shell concrete shuttering is made from commercial grade light weight building boards employing suitable connection elements. Consequently, no costly shutterings whatsoever of the types required in other placing operations will be needed.

The connection elements are provided such, that they ensure a satisfactory absorption of the shutter pressure by the light weight building boards without hindering the monolothic formation of the concrete care.

The large size of the light weight building boards enables the rapid setup of the wall.



Example of the story distribution in the case of shell concrete buildings.

It is also possible to shutter easily wall parts of any shape and size such as window posts, wall corners, gable walls, etc. by simply cutting the light weight building boards. Contrary to prefabricated lean-mixed concrete bricks of wood cement or similar materials, any ground plan standardization is avoided, and a free architectural design of the building is made possible.

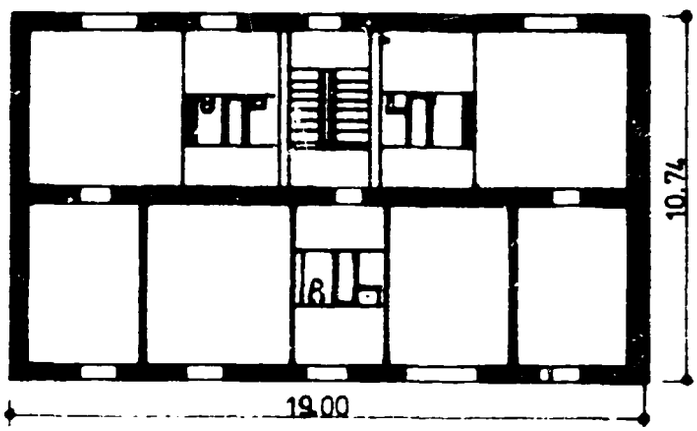
ANNEX 3/3

Minimum Cubic Yardage of the Masonry

Owing to the small wall thickness of the shell concrete, the total volume and the room round are reduced with an equal useful area of a building; in addition, the basement walls and the foundations can be dimensioned smaller because of the low dead weight of the shell concrete walls. The resultant savings, for instance, can be noted from the comparison of a brick building with a shell concrete building which is given below:

Three-storeyed dwelling house	Solid brick type of construction	Shell concrete type of construction
Useful area each story	167.3 sq.m.	
Built-up area	204.1 sq.m.	189.4 sq.m.
Room round	2,770.5 cu.m.	2,543.2 cu.m.

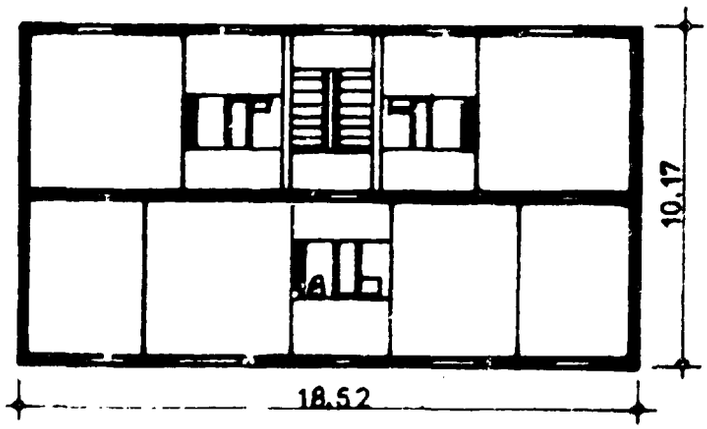
SOLID BRICK BUILDING I.



Besides the reduced wall costs of about 35 %, the shell concrete type of construction still enables the following savings:

Earth excavation	39.6 cu.m.=	9,3 %
concrete for Foundation and basement walls	49.1 cu.m.=	36.8 %
External rendering	17.1 sq.m.=	3.6 %
Roof truss	15.8 sq.m.=	6.8 %
Roof covering	22.3 sq.m.=	6.8 %
Gutter and cutoff edge	1.9 sq.m.=	3.0 %

SHELL CONCRETE CONSTRUCTION II.



The substantially reduced building material requirements can be noted from the following comparison:

Total weight of the load bearing walls including basement walls and foundations solid brick type of construction:
776 tons (metric)
shell concrete type of construction:
419 tons (metric)

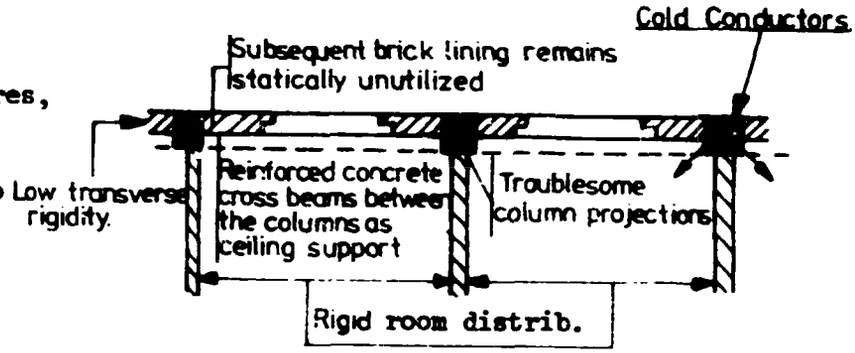
This indicates that 357 tons (metric) or about 100 truckages of building materials are economized already in the case of a small dwelling house project when employing the shell concrete type of construction.

ANNEX 3/4

Monolithic wall element

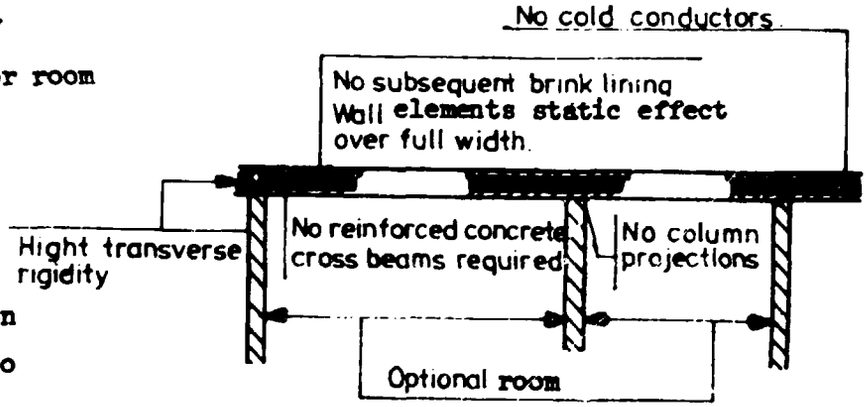
The monolithic concrete core of the shell concrete wall forms a rigin wall element which proves to be superior to the skeleton structure both from the engineering and the economic points of view.

In the case of skeleton structures, the ceiling and wall loads must first of all be transmitted onto coloumns by cross beams, passed off in these columns in a concentrated form, and finally, redistributed on the foundation soil by widened footings.



LAYOUT OF THE REINFORCED CONCRETE SKELETON

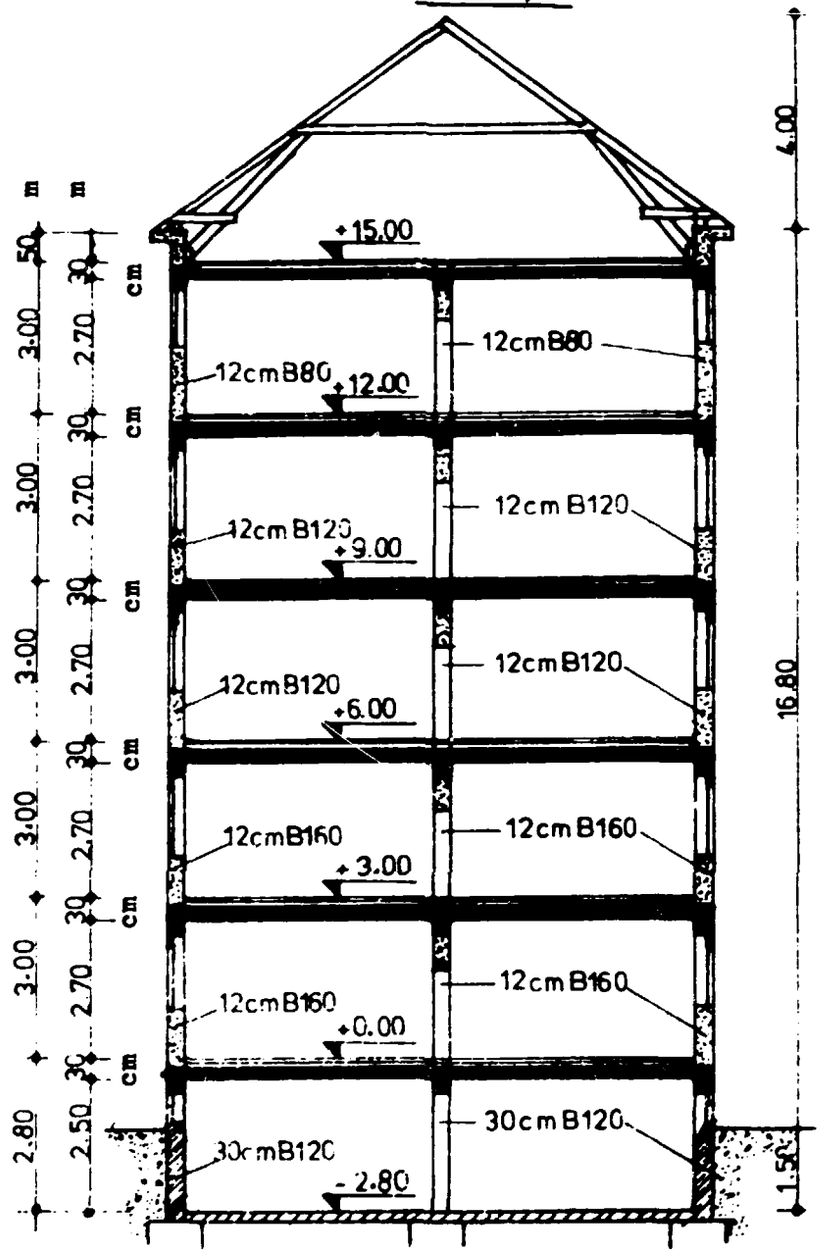
A subsequent web bracing of the skeleton is required for room closure. This web bracing remains static causing an additional loading of the supporting framework. The rigidity of the skeleton construction when subject to horizontal loads from wind pressure is relatively low, the solution of the ground plan problem is complicated by the rigid column distribution, and cold conductors are frequently found in way of the reinforced concrete columns.



LAYOUT OF THE SHELL CONCRETE ELEMENT

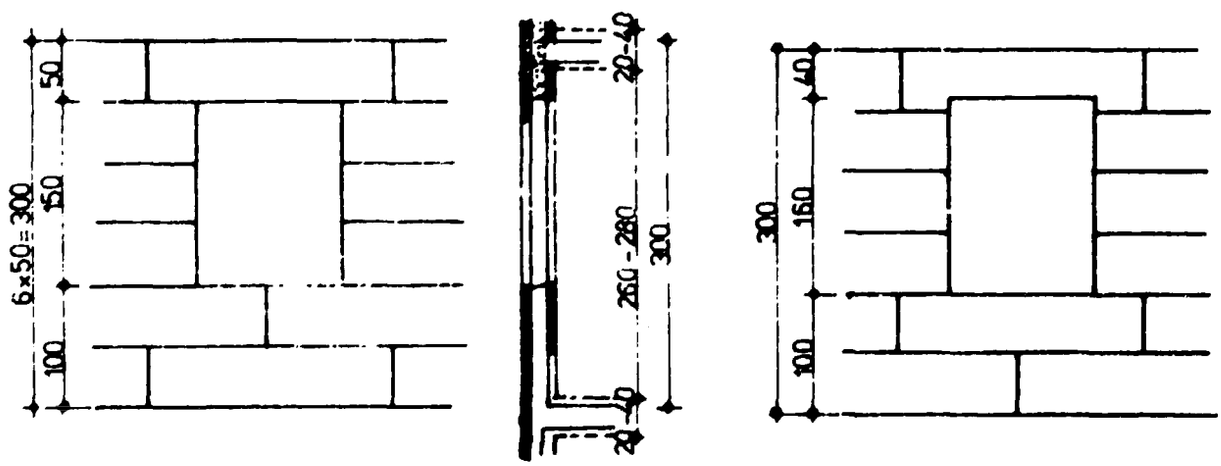
The disadvantages of the skeleton construction are completely eliminated in the case of shell concrete buildings, and apart from the substantially simplified completion of the building, considerable savings of building materials, particularly also of steel and timber form are achieved.

ANNEX 4/1

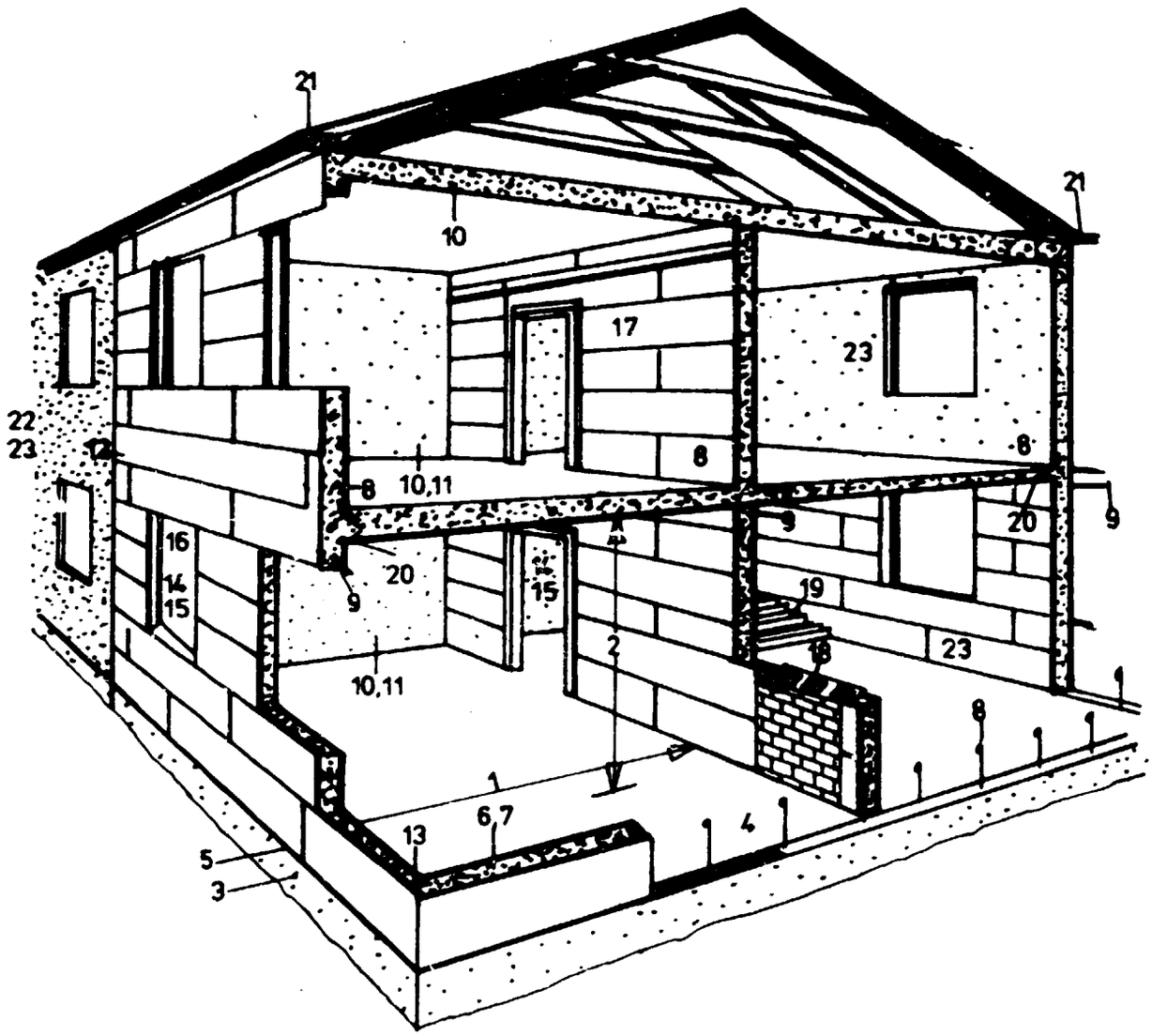


Sectional View of a Shell Concrete Building

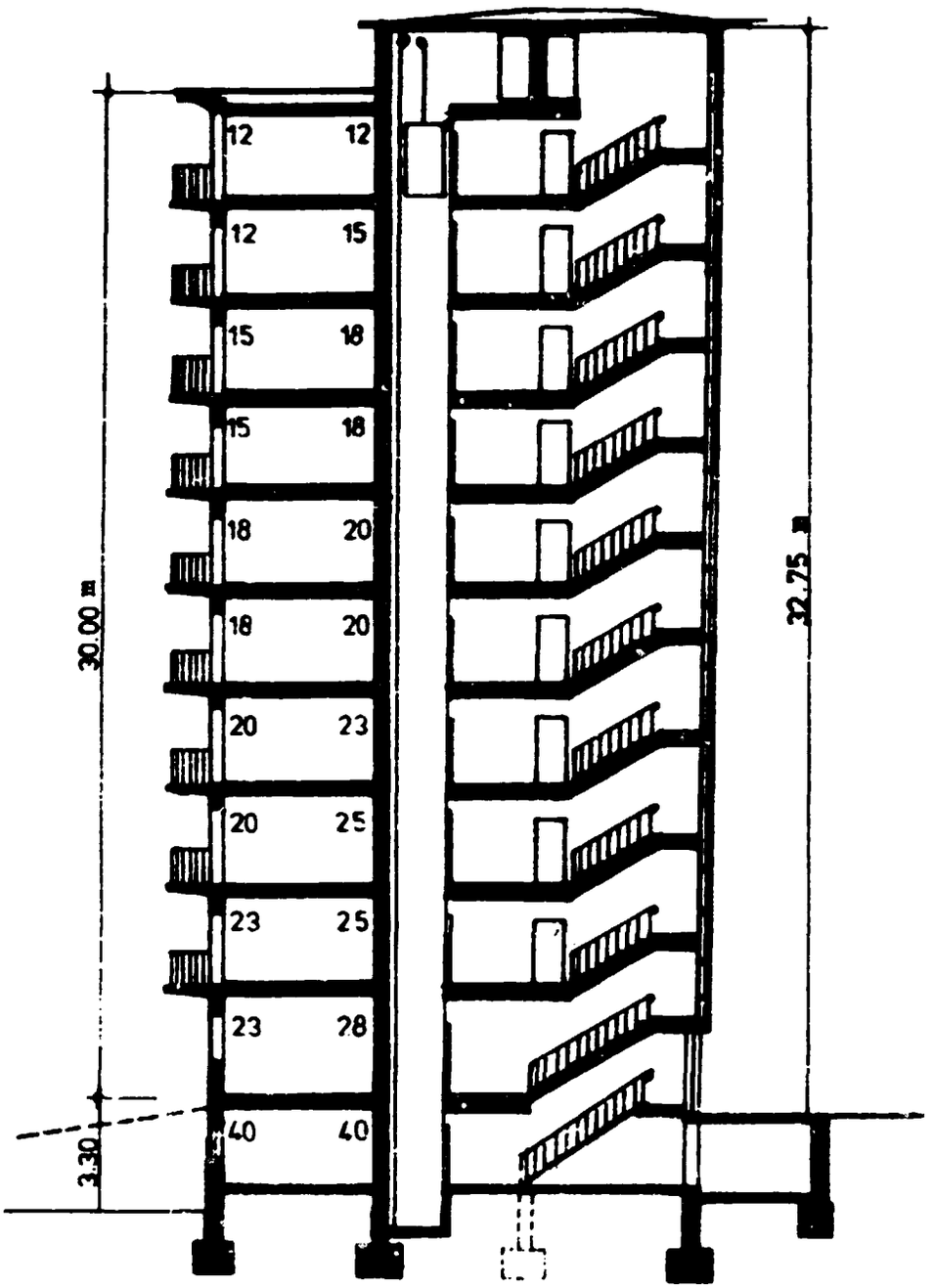
Examples of Storey Distribution and Arrangement of the Wall Openings



ANNEX 4/2



1. Ground plan
2. Story distribution
3. Basement walls
4. Horizontal insulation
5. Arrangement of base
6. Dimensioning of the shell concrete walls
7. Arrangement of the shell concrete walls
8. Tie
9. Closure
10. Bracing cross walls
11. Partitions
12. Separation joints
13. Wall corners
14. Windows and doors
15. Arrangement at the wall opening
16. Auxiliary openings
17. Electric wiring
18. Smoke flyes
19. Stairs
20. Ceiling support
21. Cornices
22. Framing
23. Plaster

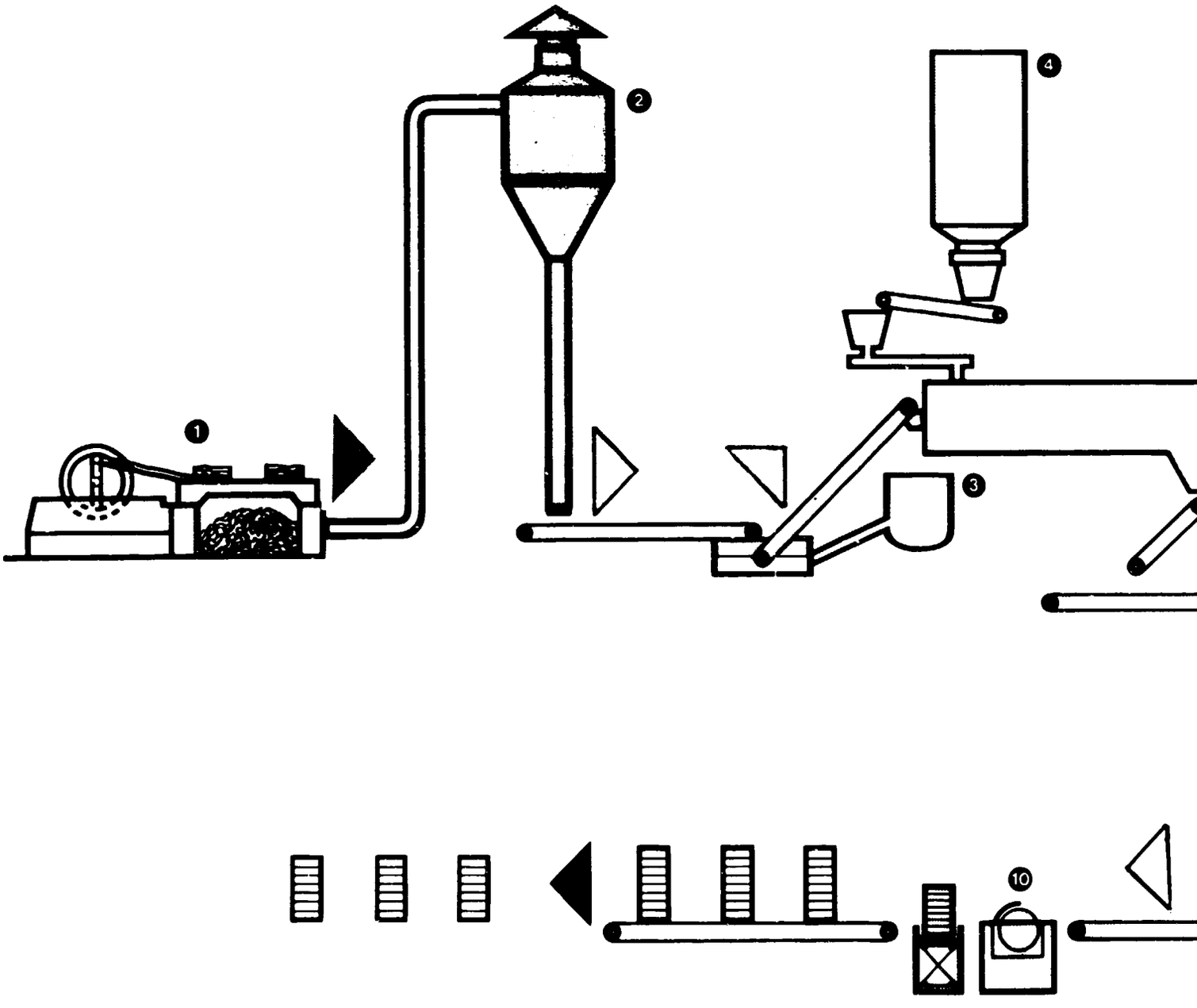


Distribution of Storeys

Any storey height desired can be provided by simply custom tailoring the light weight building board. In order to have a, preferably, small board abatement however, it is recommended that a size which is divisible by 50 cm or 25 cm (= total or half width of board) will be selected. The total storey height being assumed at 3.00 m as the normal case, but heights of 2.60 to 2.80 m, depending on the ceiling and floor construction can be established. The smallest board abatement is obtained at a window height of 1.50 m wall clear (about 1.46 architecture clear). In the case of greater window heights and door openings, a correspondingly longer side stip should be cut from uppermost board cluster.

ANNEX V

Light weight building board installations Type: C and CK



SECTION 1

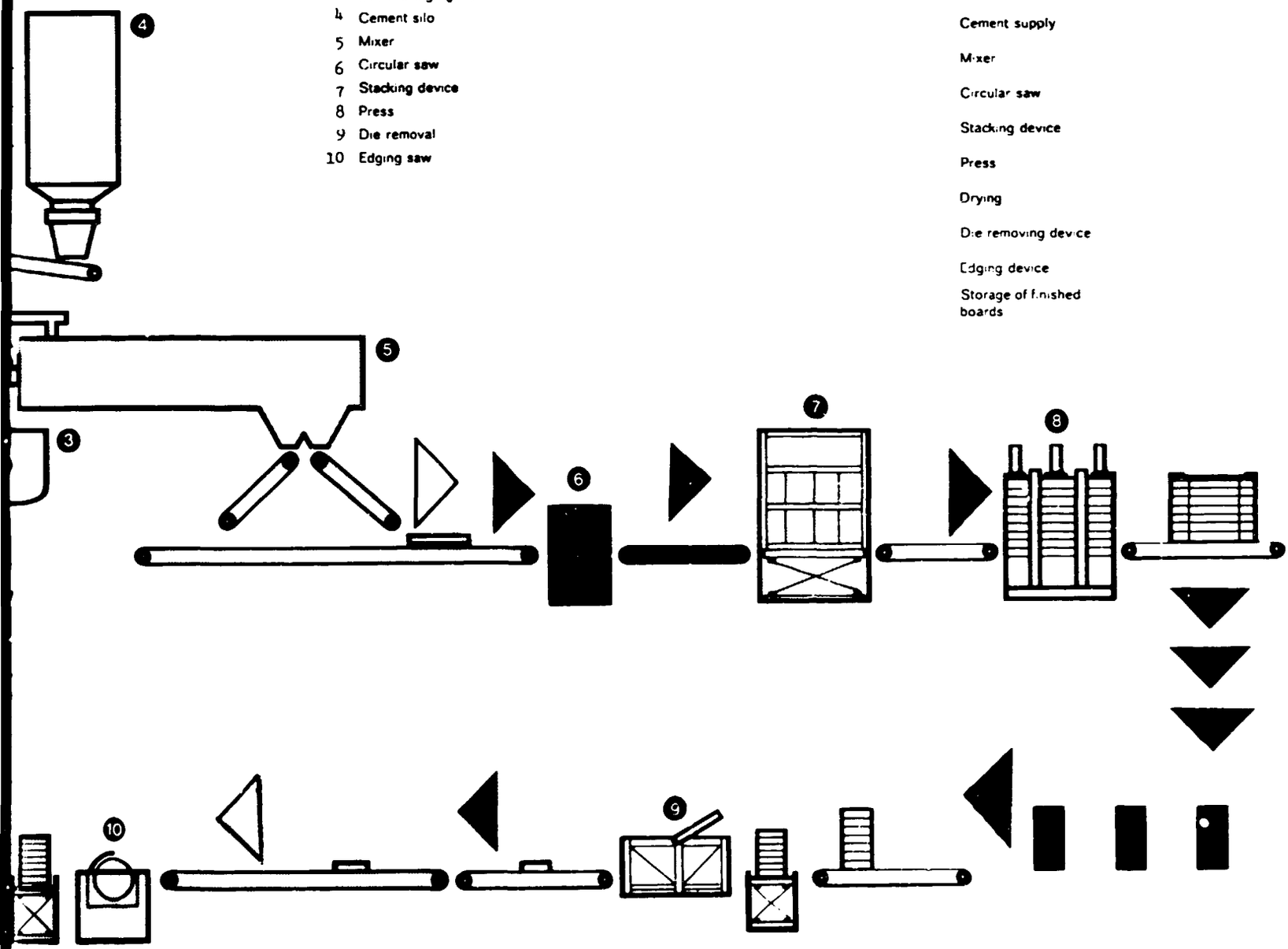
ANNEX V

Arrangement of machines

1 Wood wool machine
2 Wood wool silo
3 Container for mineralizing agent
4 Cement silo
5 Mixer
6 Circular saw
7 Stacking device
8 Press
9 Die removal
10 Edging saw

Working sequences

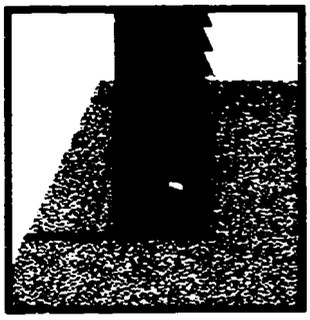
Wood wool production
Preparation of wood wool
Mineralization
Cement supply
Mixer
Circular saw
Stacking device
Press
Drying
Die removing device
Edging device
Storage of finished boards



SECTION 2

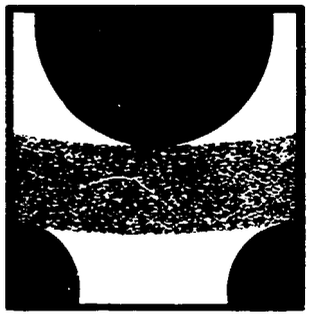
ANNEX 6/1

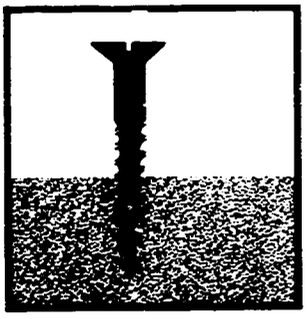
FEATURES OF LIGHT WEIGHT BUILDING BOARDS

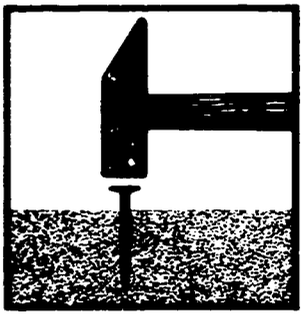


Light-weight building boards have excellent static properties, such as high tensile strength, compression strength, and supporting properties.

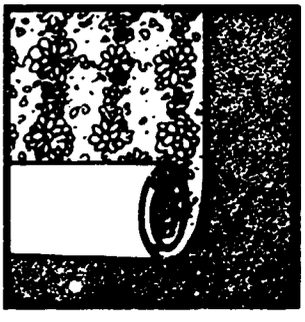
Light-weight building boards are easy to machine, i. e. to cross-cut, to shape, to screw, to nail etc.

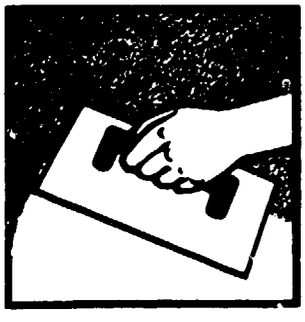




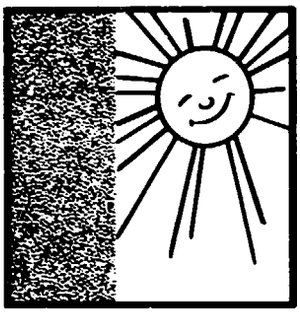


Light-weight building boards are waterproof, particularly suitable for plastering, are easy to fill, to spray, to paint, and to paper.

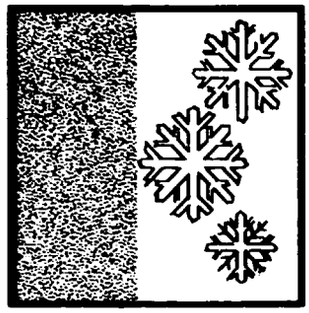


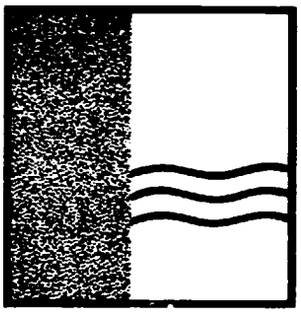


ANNEX 6/2



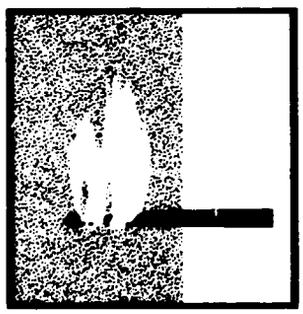
Light-weight building boards are characterized by their excellent thermal insulating and sound absorbing properties.

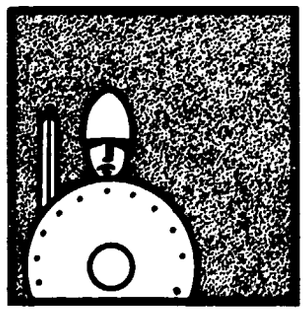




Light-weight building boards are fire-resistant.

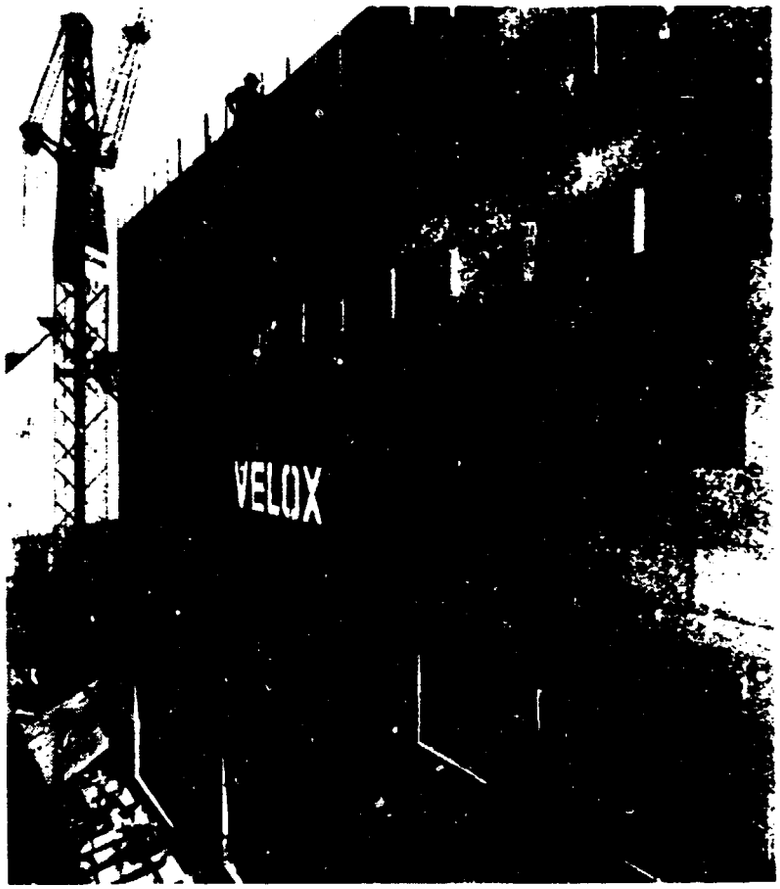
Light-weight building boards are resistant to thermites and fungus.

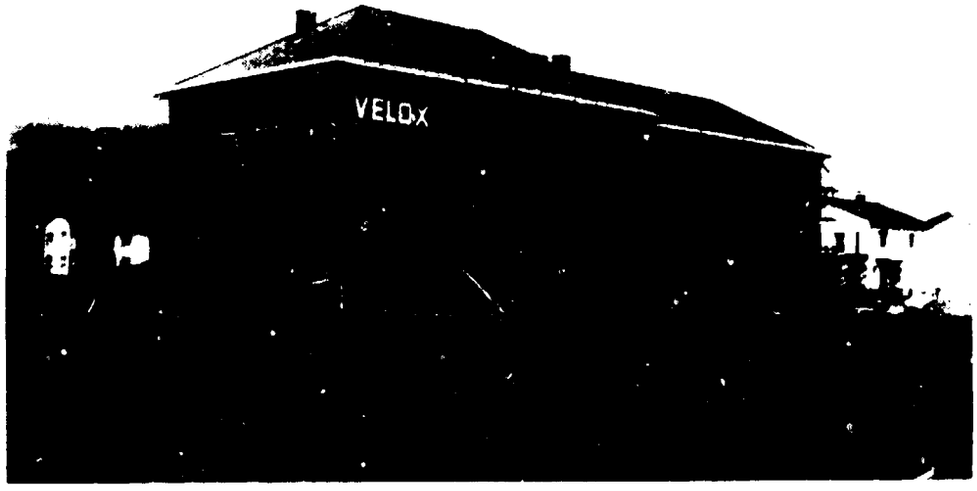




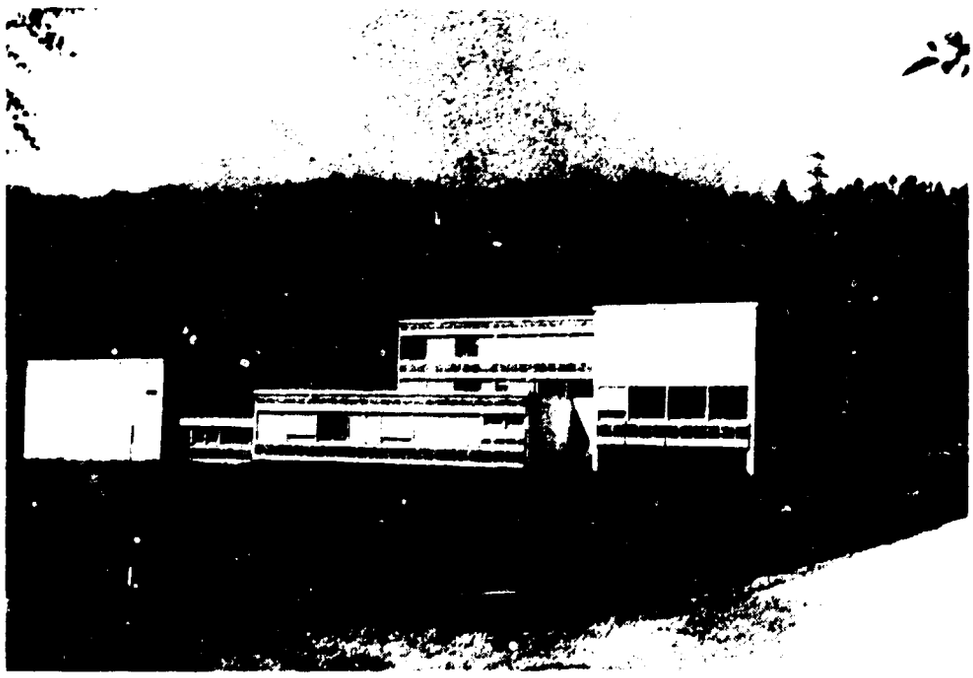
ANNEX 7

Some Detailed Photographs

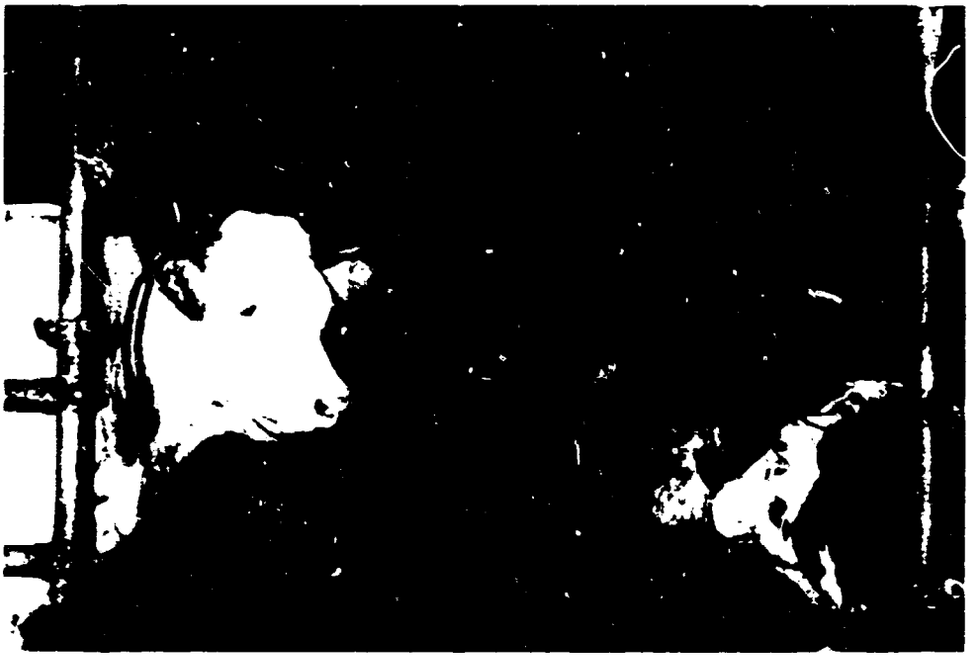




ANNEX 7/2

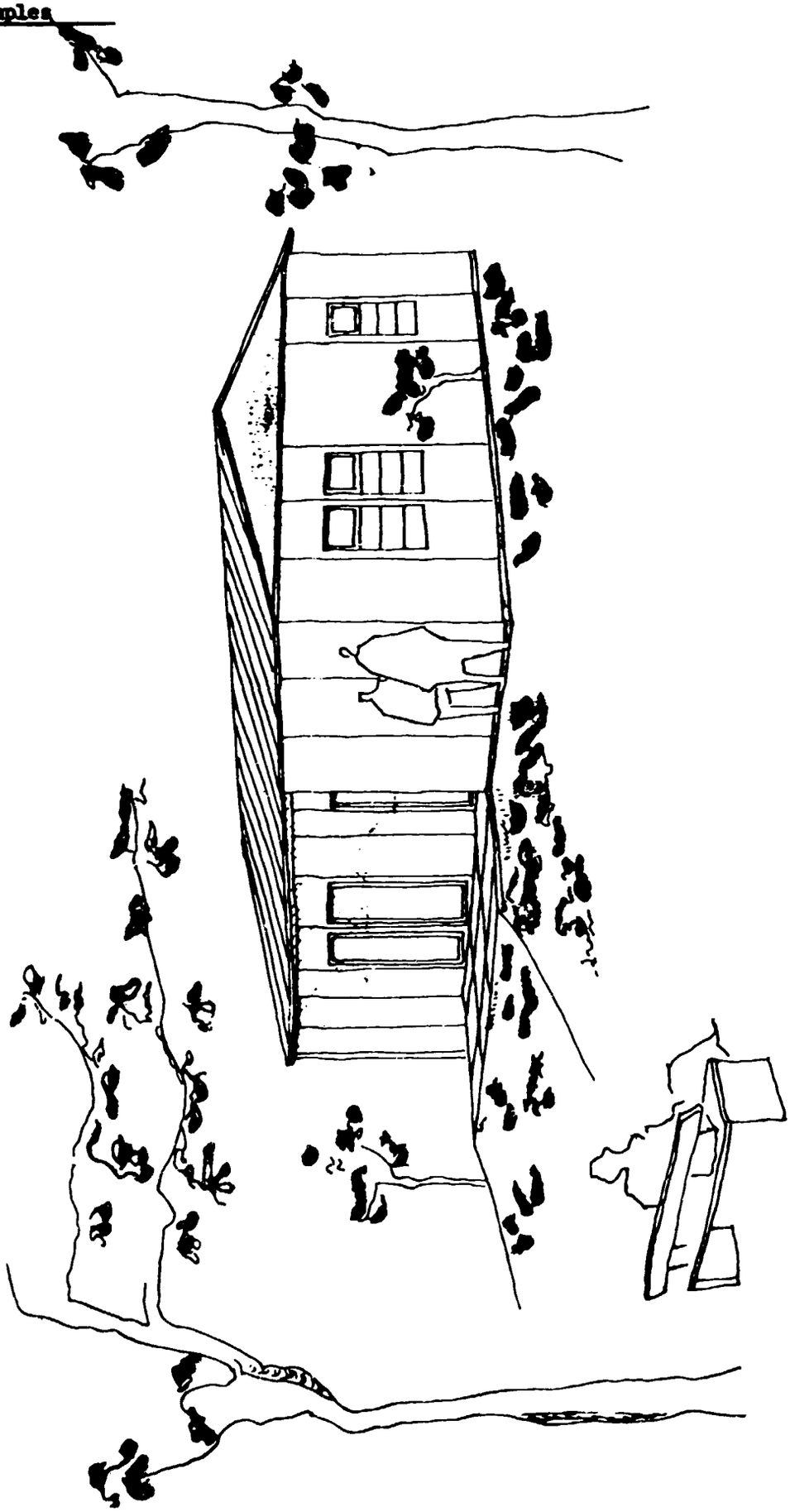


ANNEX 7/3

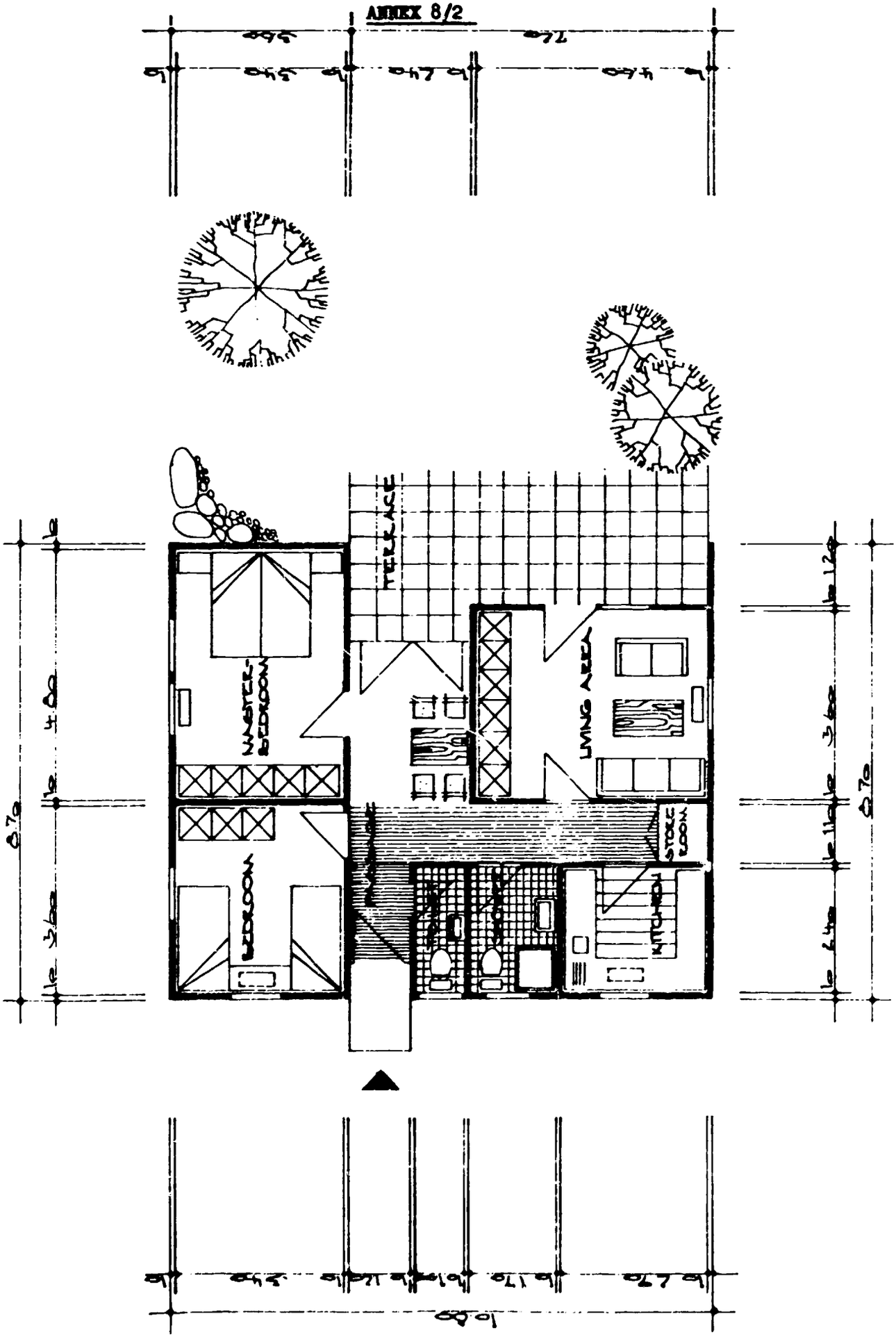


ANNEX 8

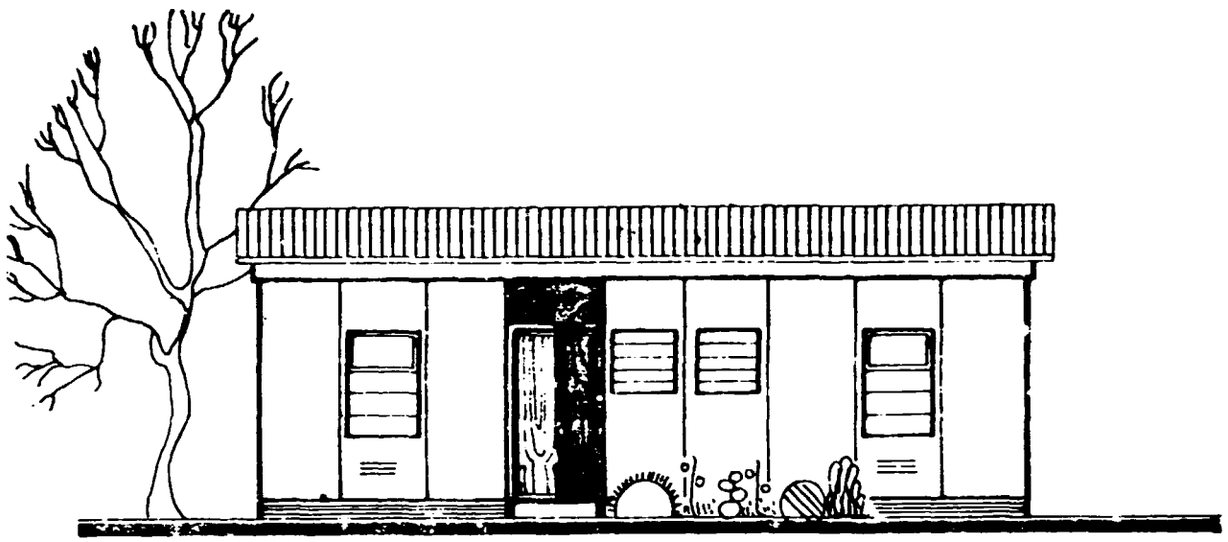
Some Flat Samples

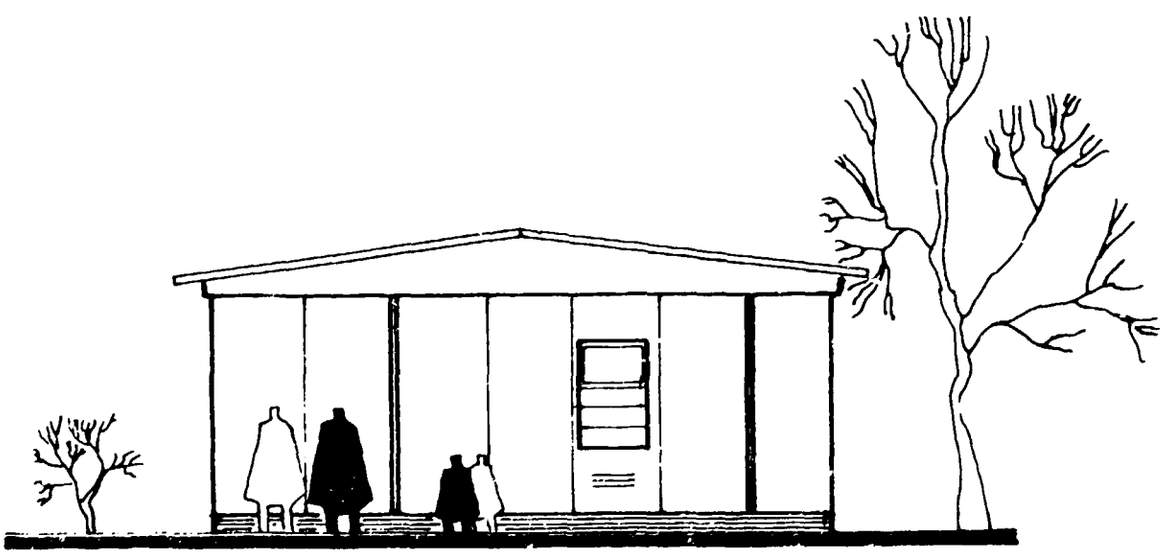


ANNEX 8/2

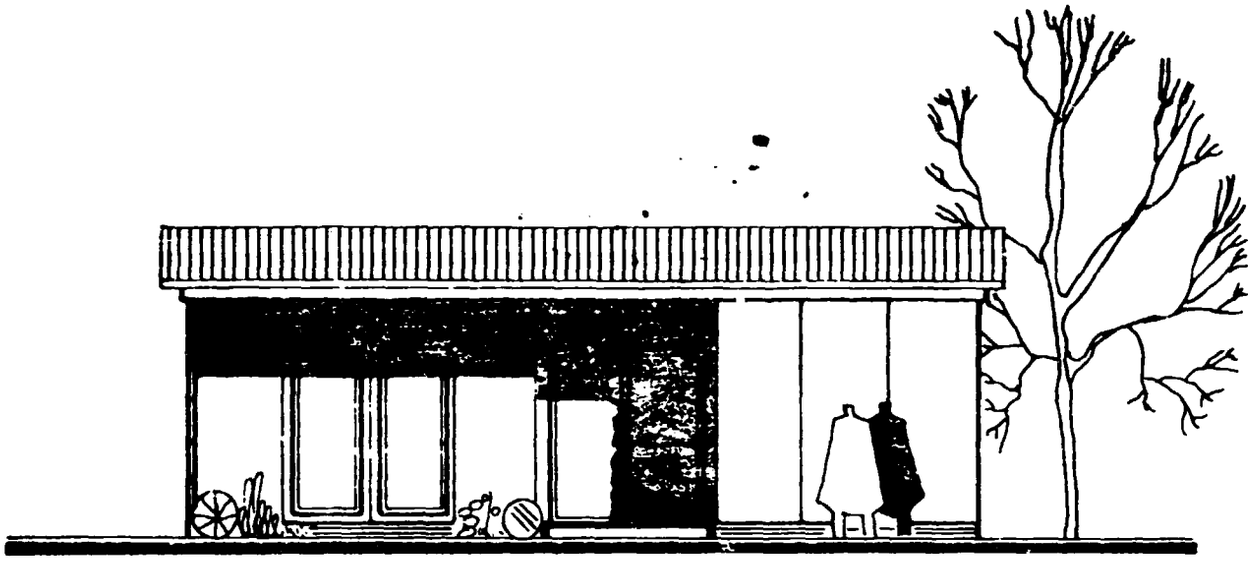

TERRACE
MASTER BEDROOM
LIVING AREA
BEDROOM
STORE ROOM
KITCHEN

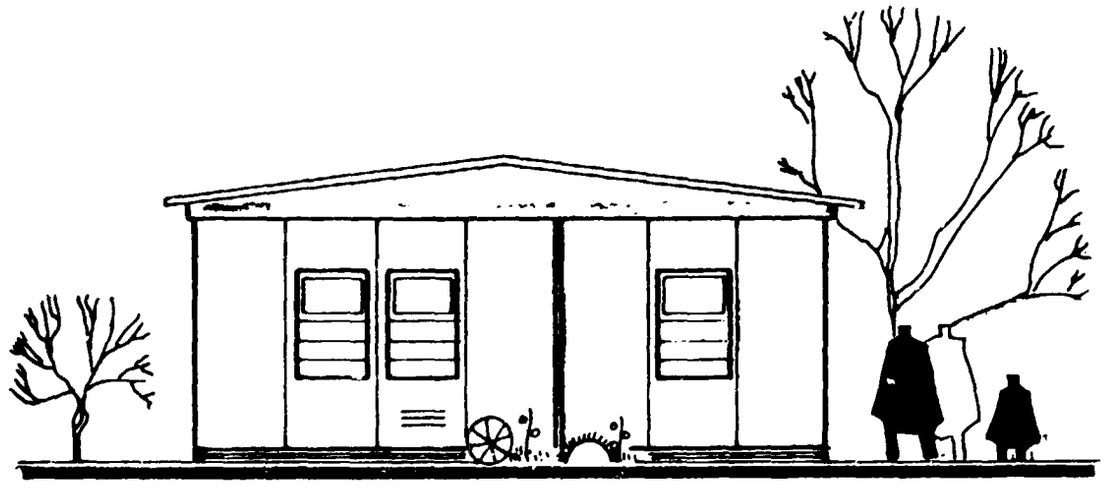
ANNEX 8/3



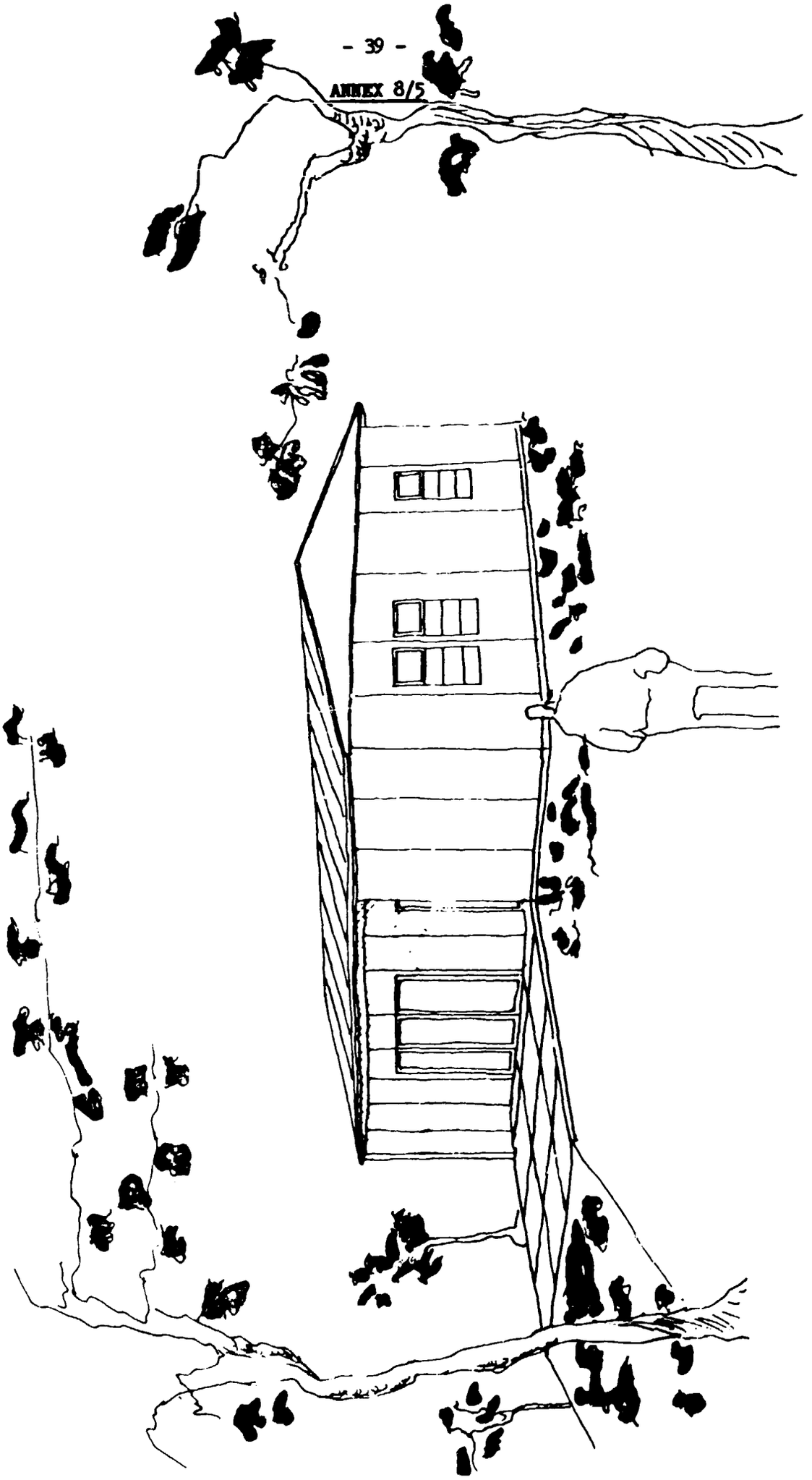


ANNEX 8/4

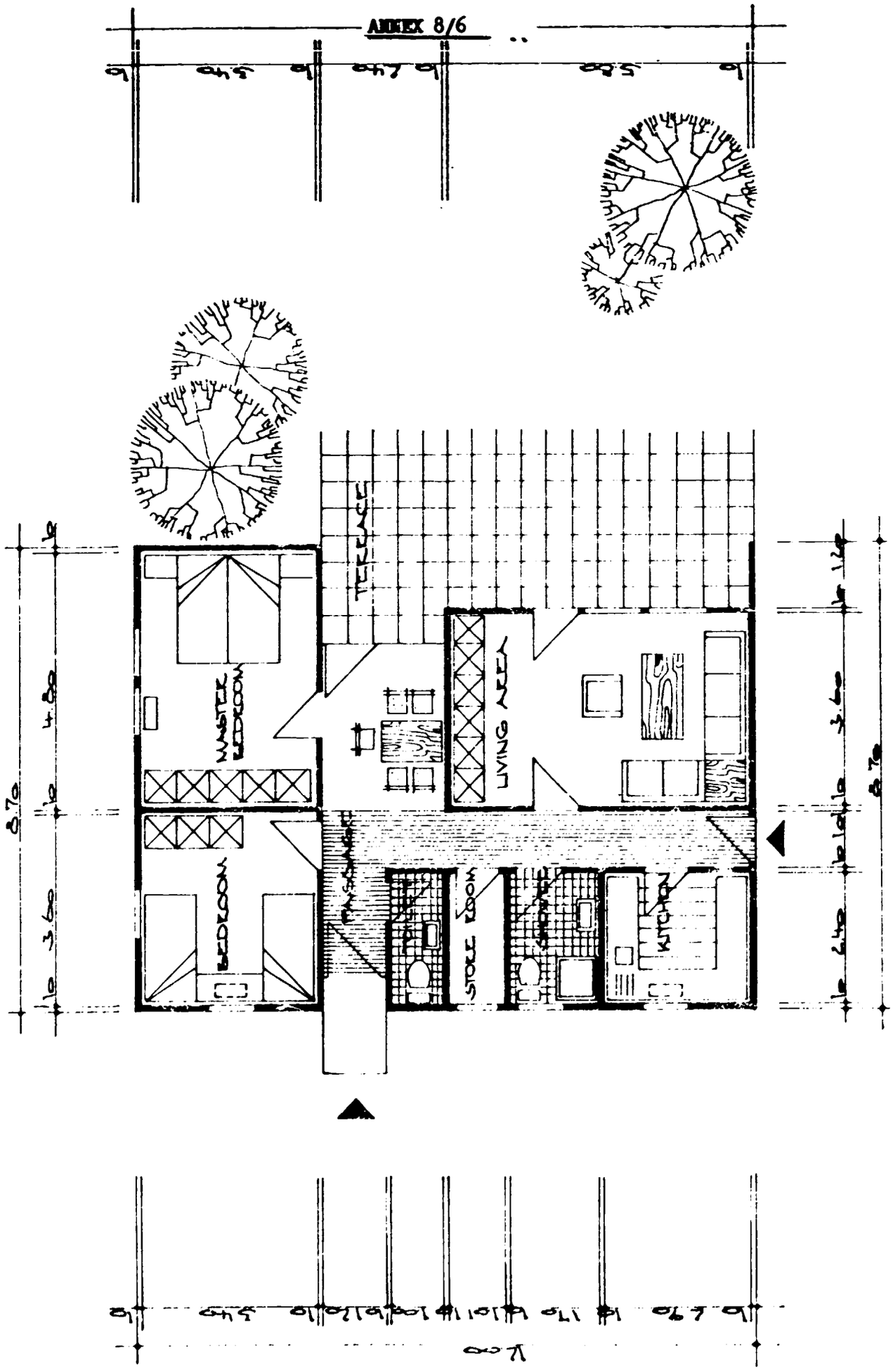




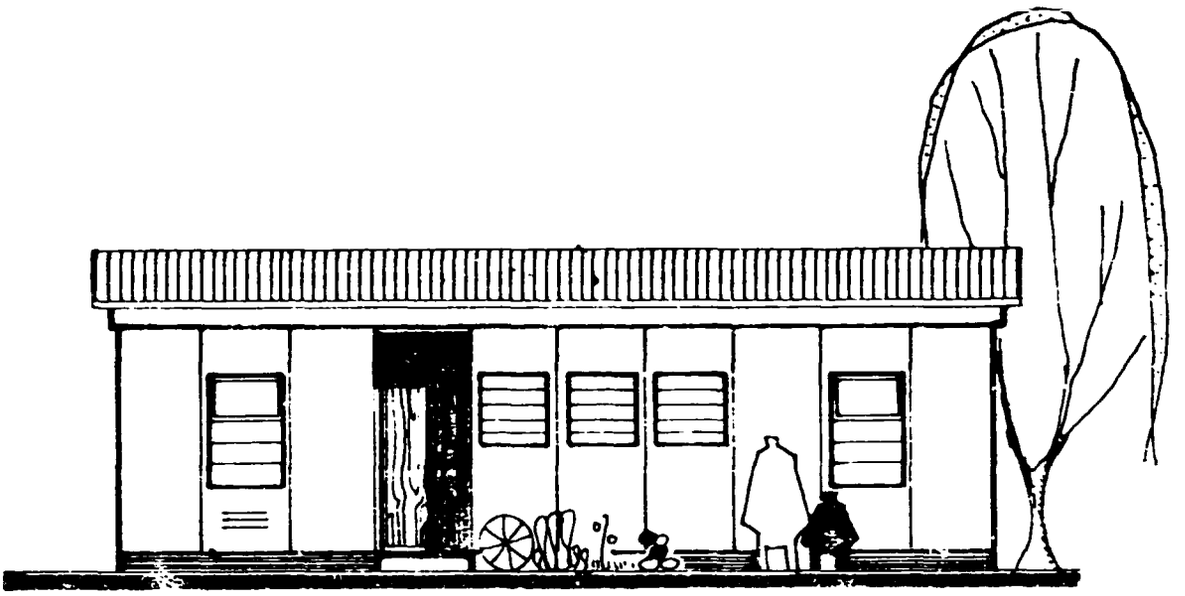
ANNEX 8/5

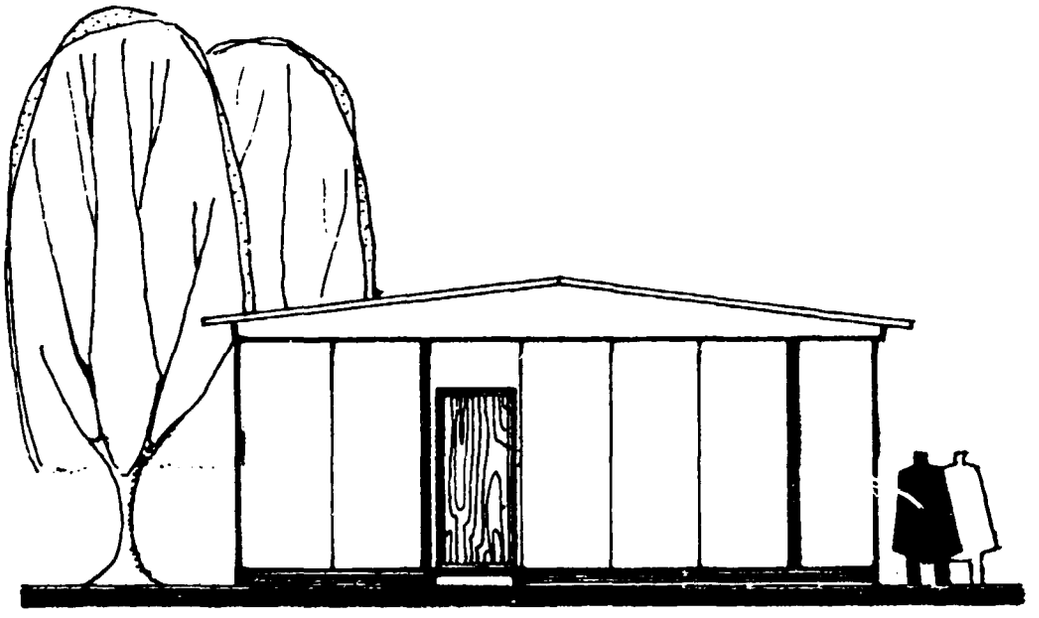


ANNEX 8/6

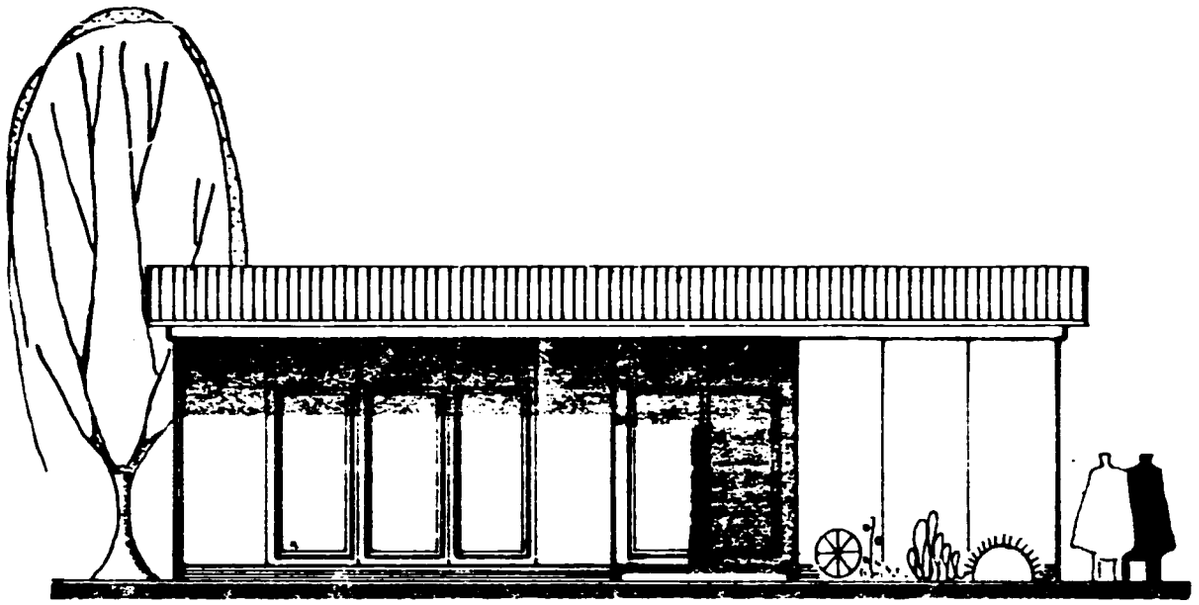

TERRACE
LIVING AREA
MASTER BEDROOM
BEDROOM
STORE ROOM
KITCHEN

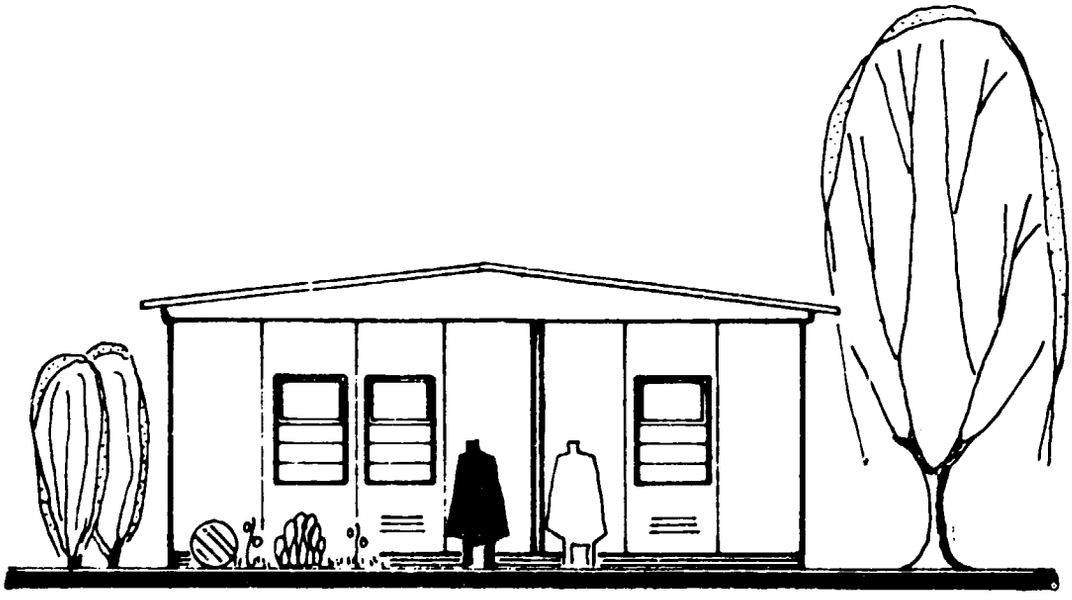
ANNEX 8/7



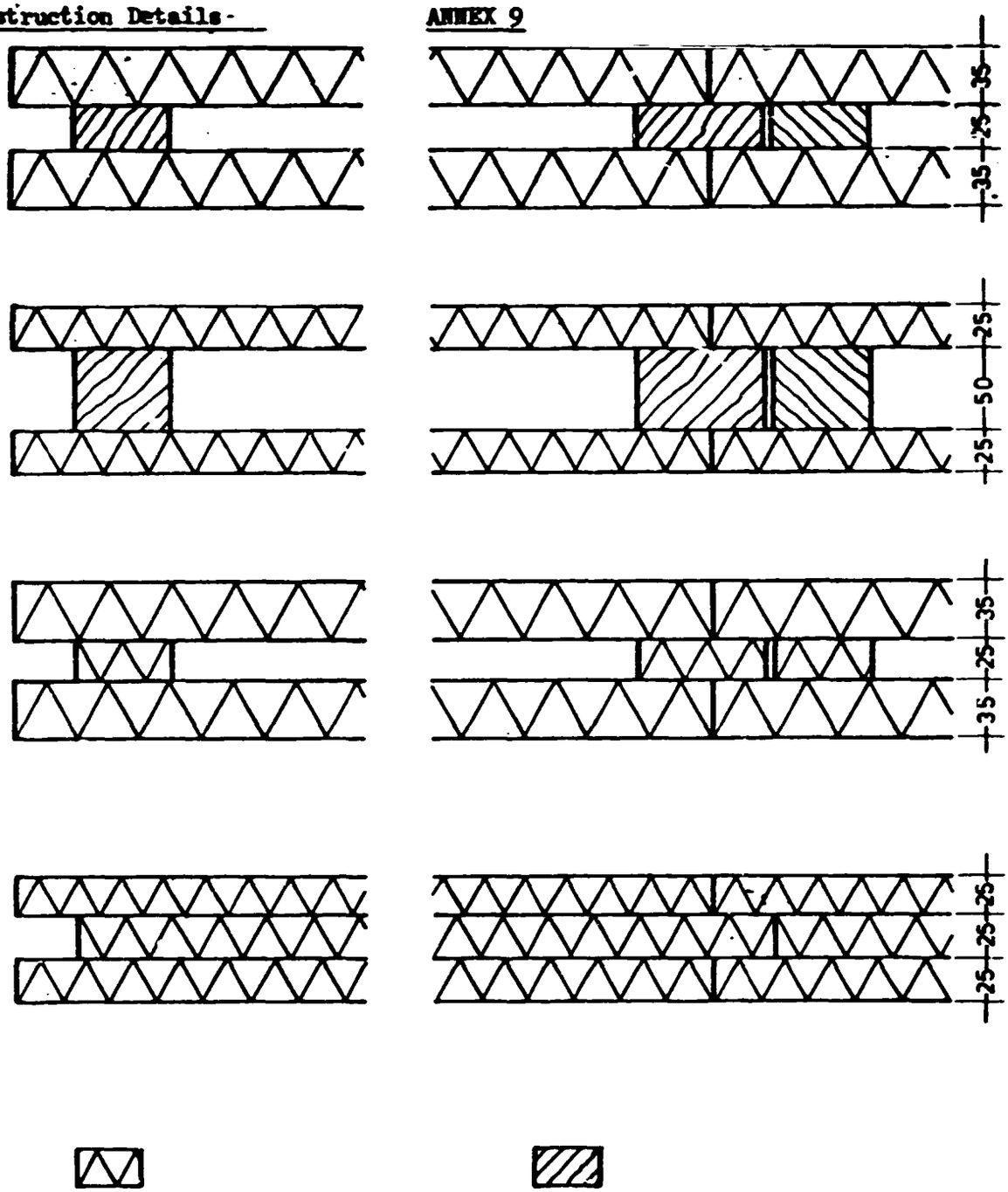


ANNEX 8/8





Construction Details - **ANNEX 9**

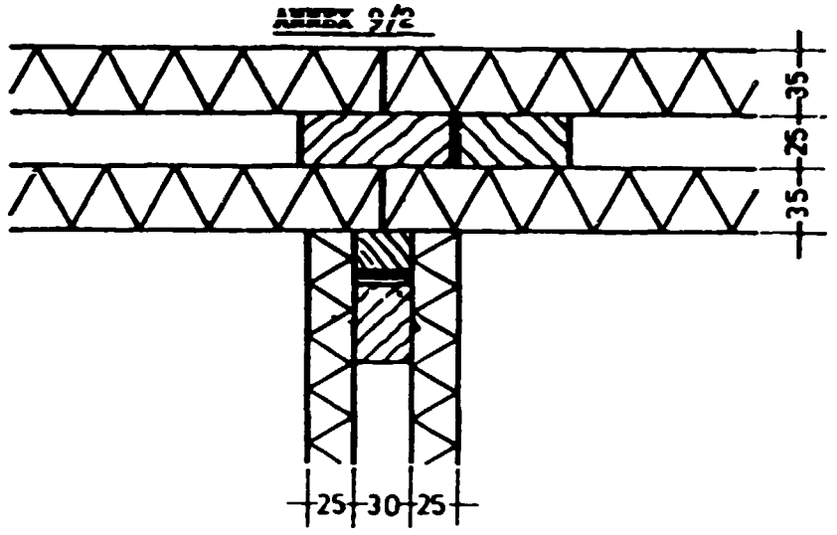


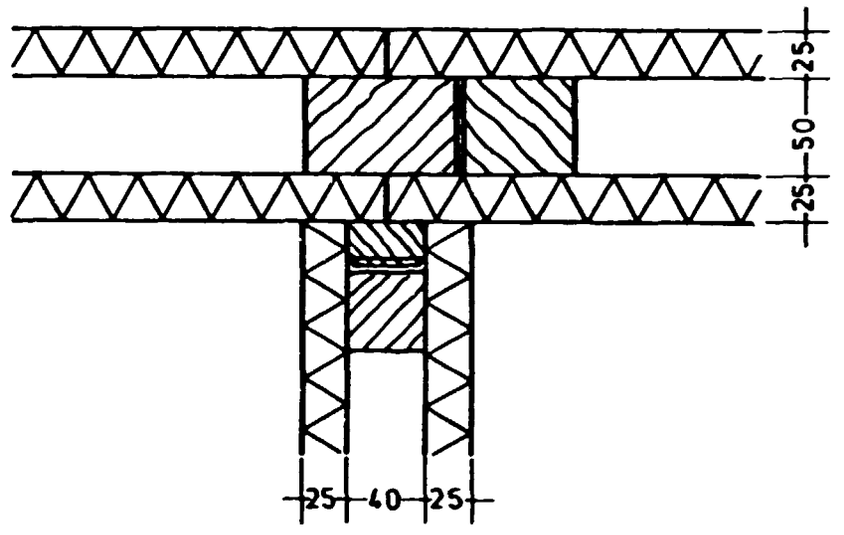
building board

timber

connecting part : outer wall - outer wall

ANNEX 9/2



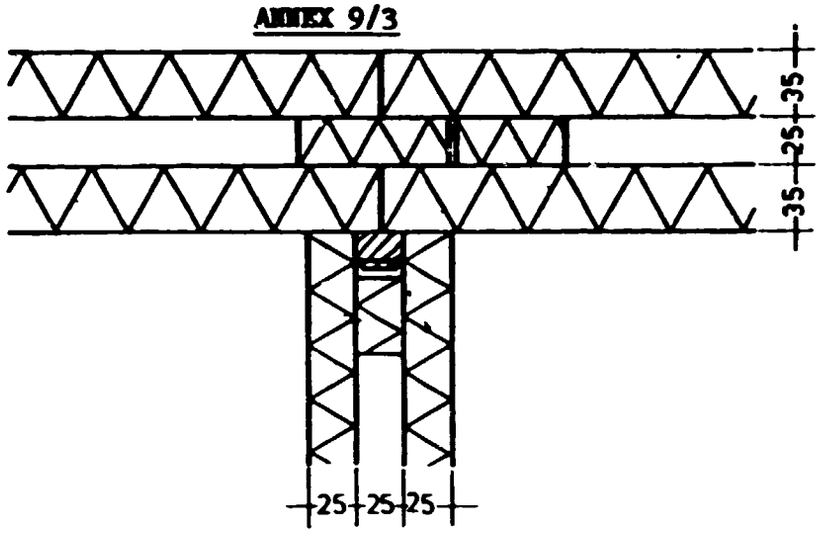


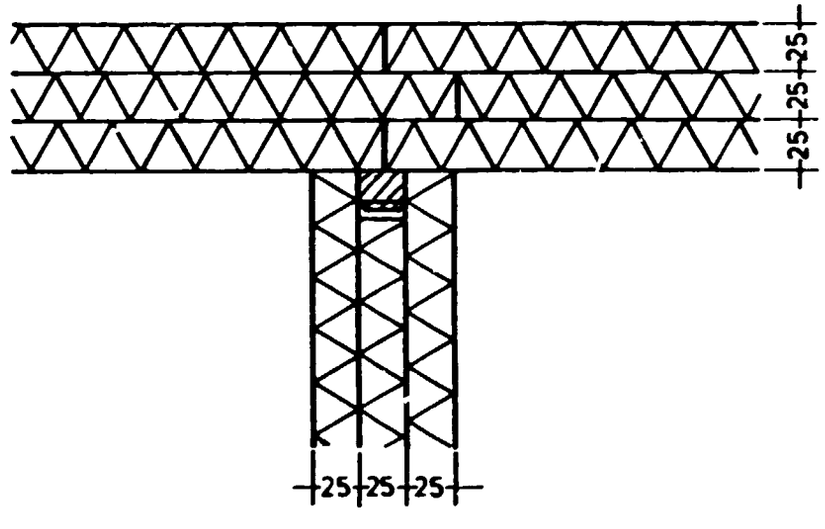
building board

timber

connecting part : outer wall - interior wall

ANNEX 9/3



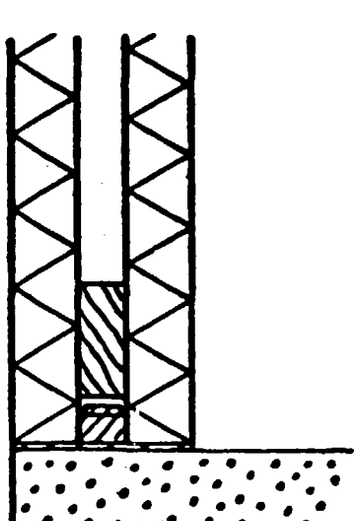


building board

timber

connecting part : outer wall - interior wall

ANNEX 9/4



building board

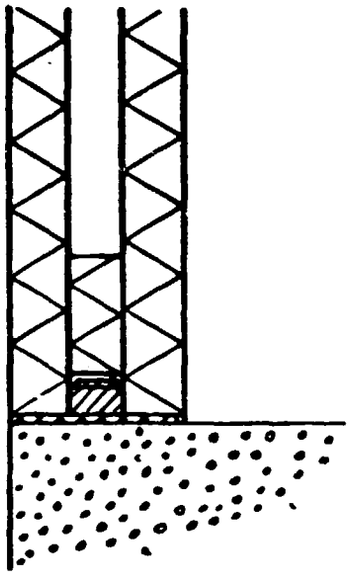
timber

foundation

tarred felt

connecting part : foundation - outer wall

ANNEX 9/5



building board

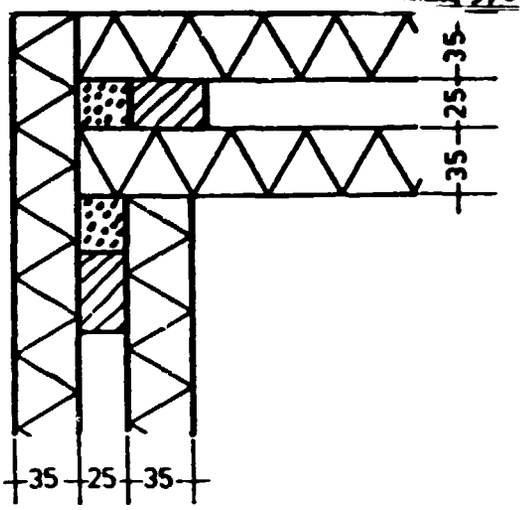
timber

foundation

tarred felt

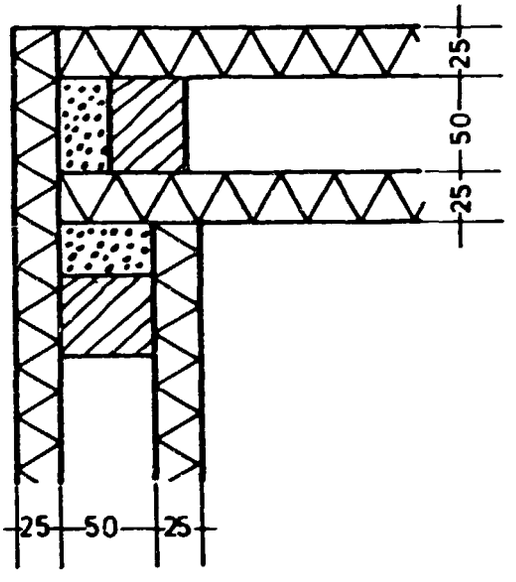
connecting part : foundation - outer wall

ANNEX 9/6



building board

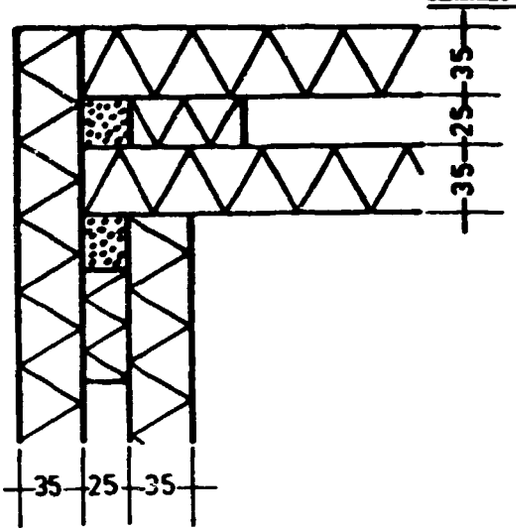
timber



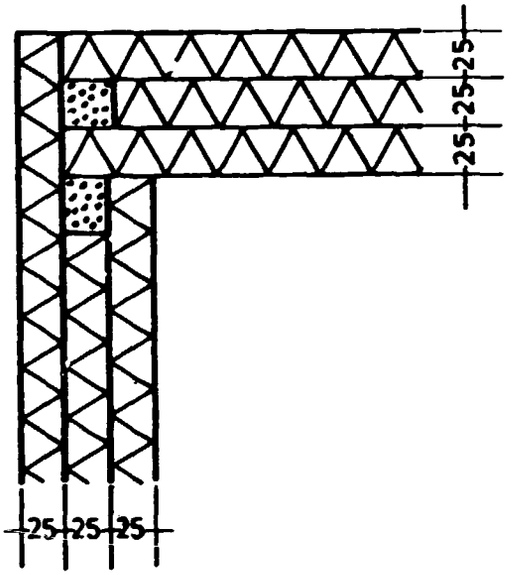
concrete

angular connecting part

ANNEX 9/7

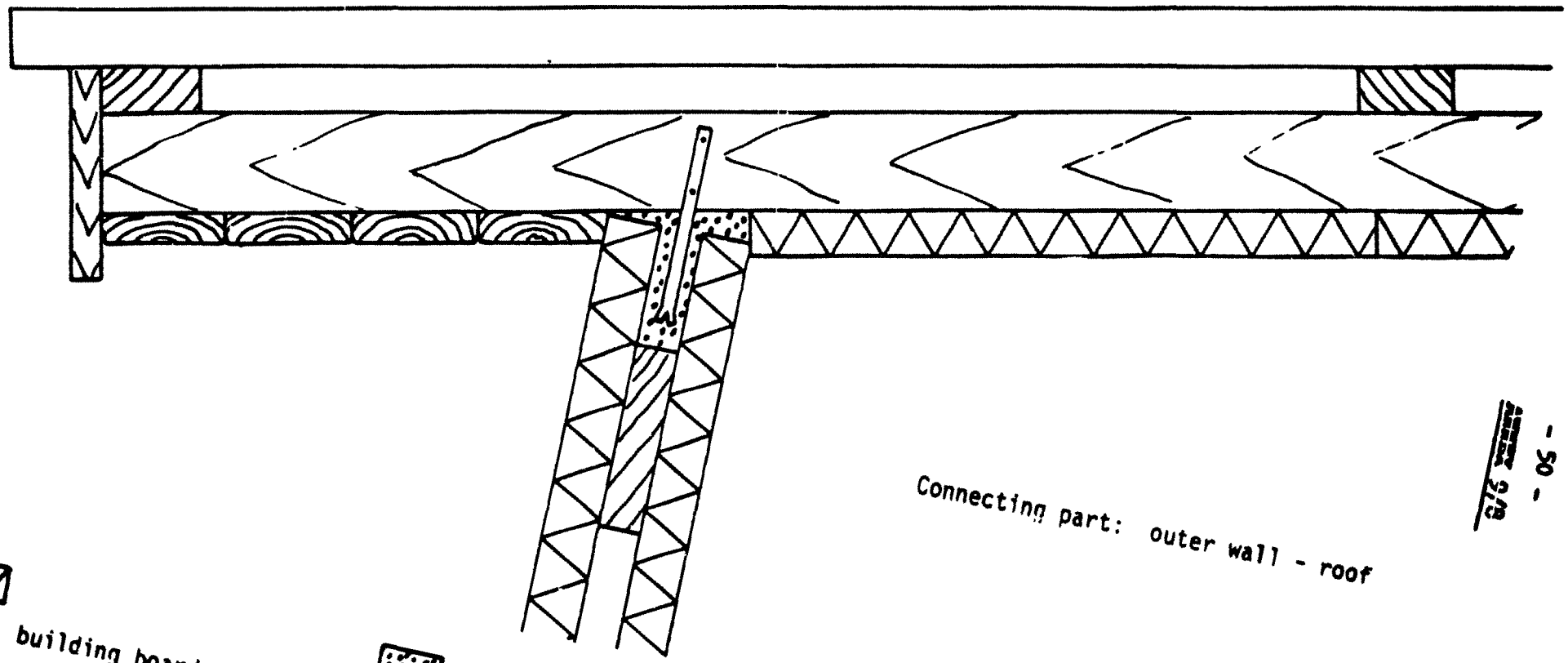


building board



concrete

angular connecting part



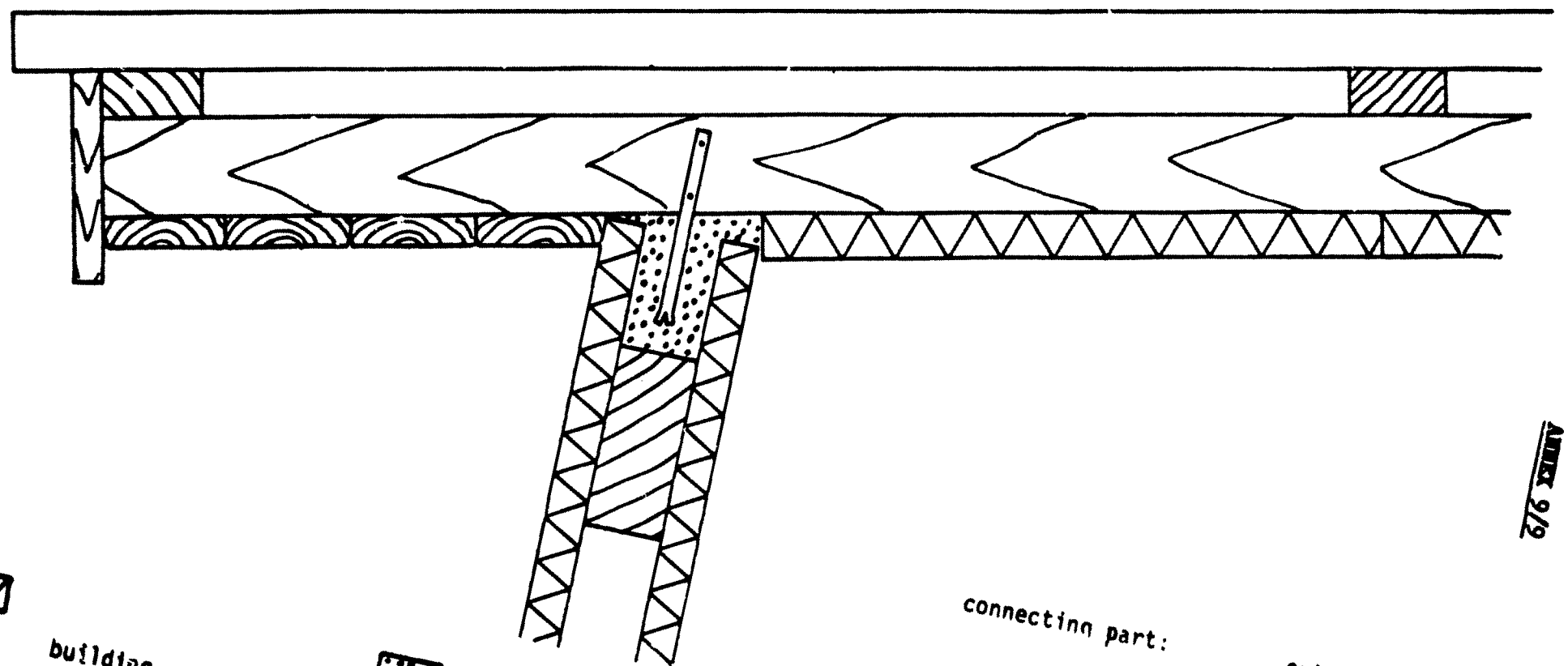
Connecting part: outer wall - roof

building board

concrete

timber

timber



building board

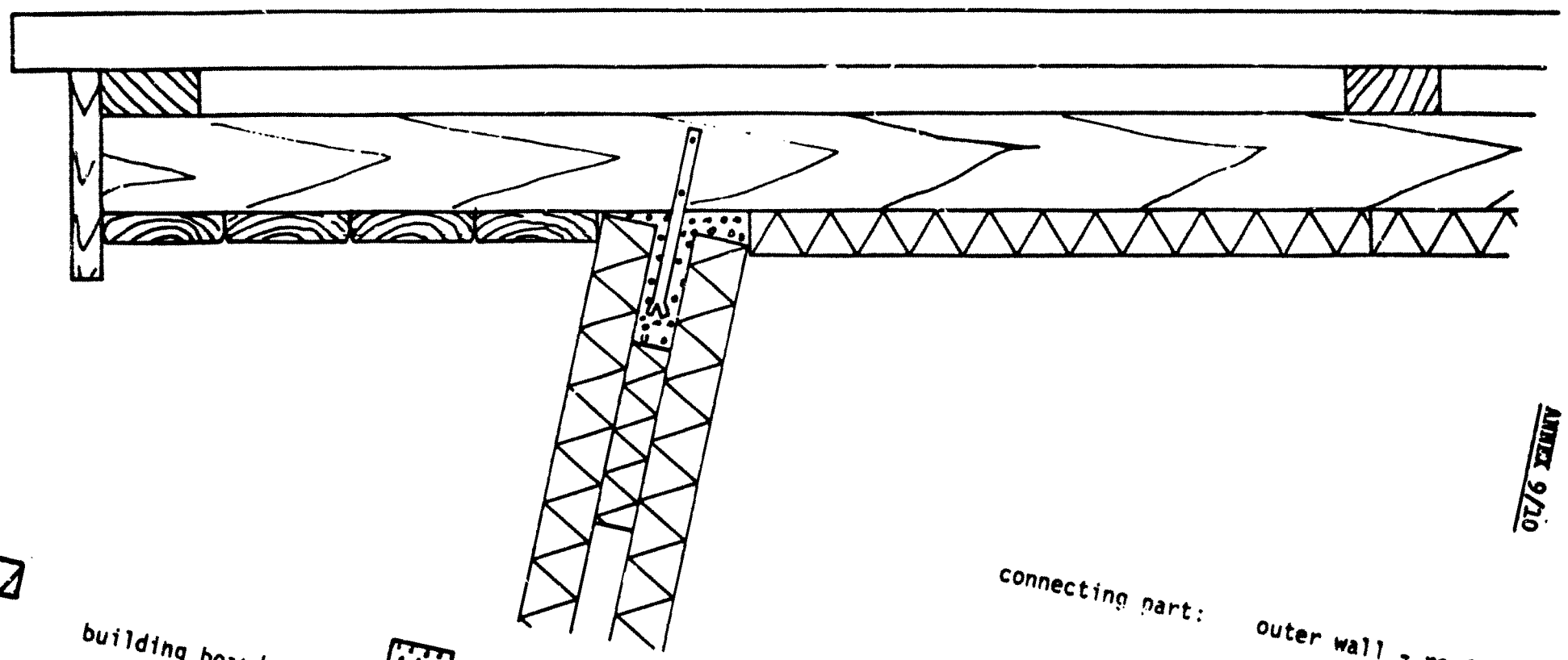
concrete

connectinn part:

outer wall - roof

timber

timber



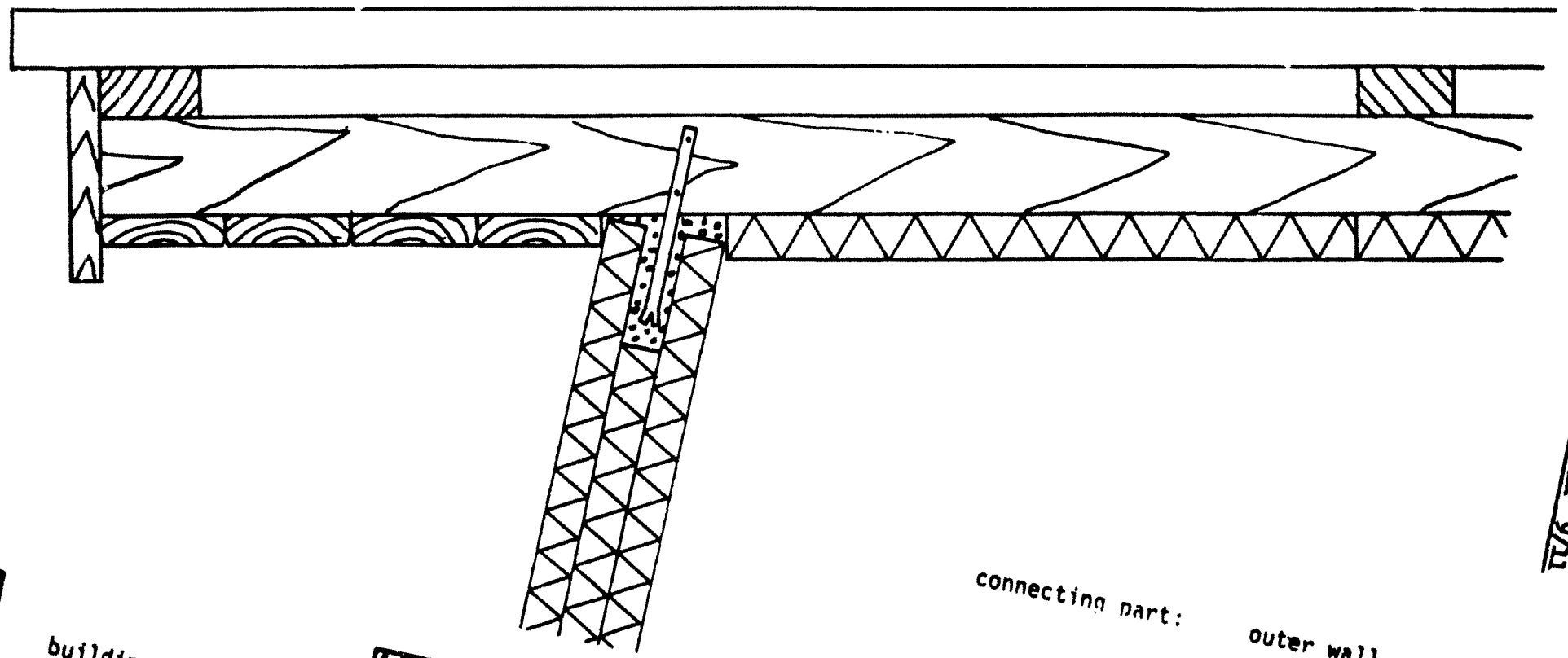
building board

concrete

connecting part: outer wall - roof

timber

timber



building board

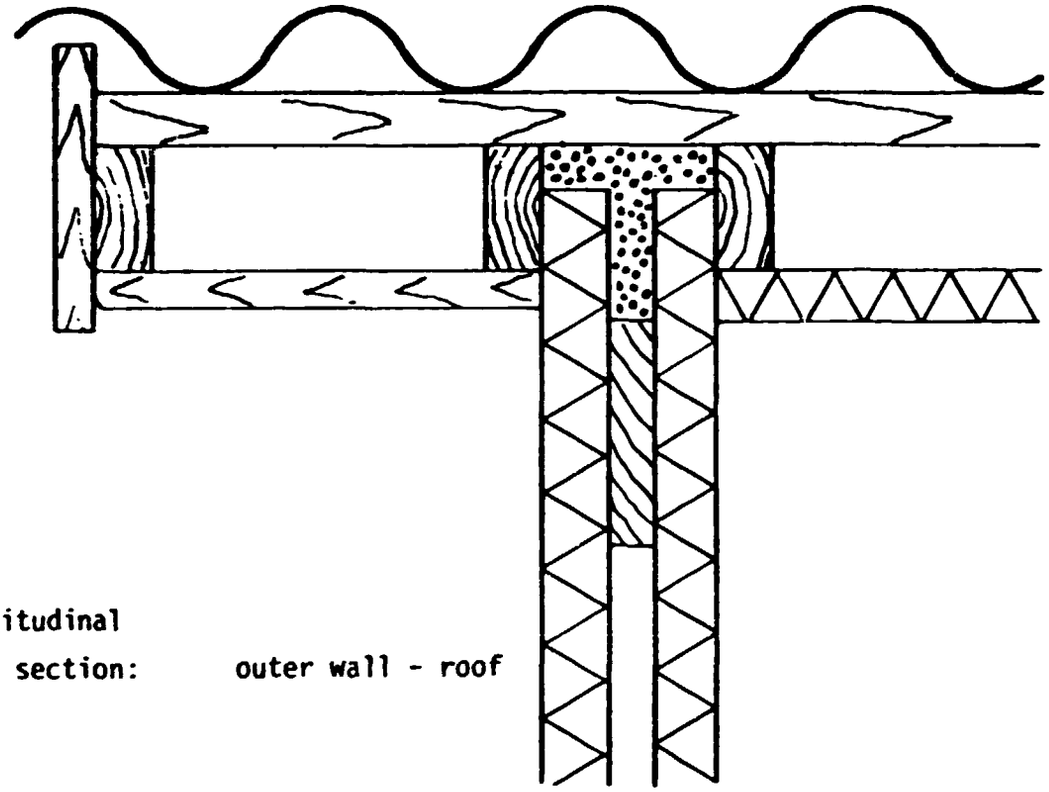
concrete

connecting part: outer wall - roof

timber

timber

ANNEX 9/12



Longitudinal section: outer wall - roof

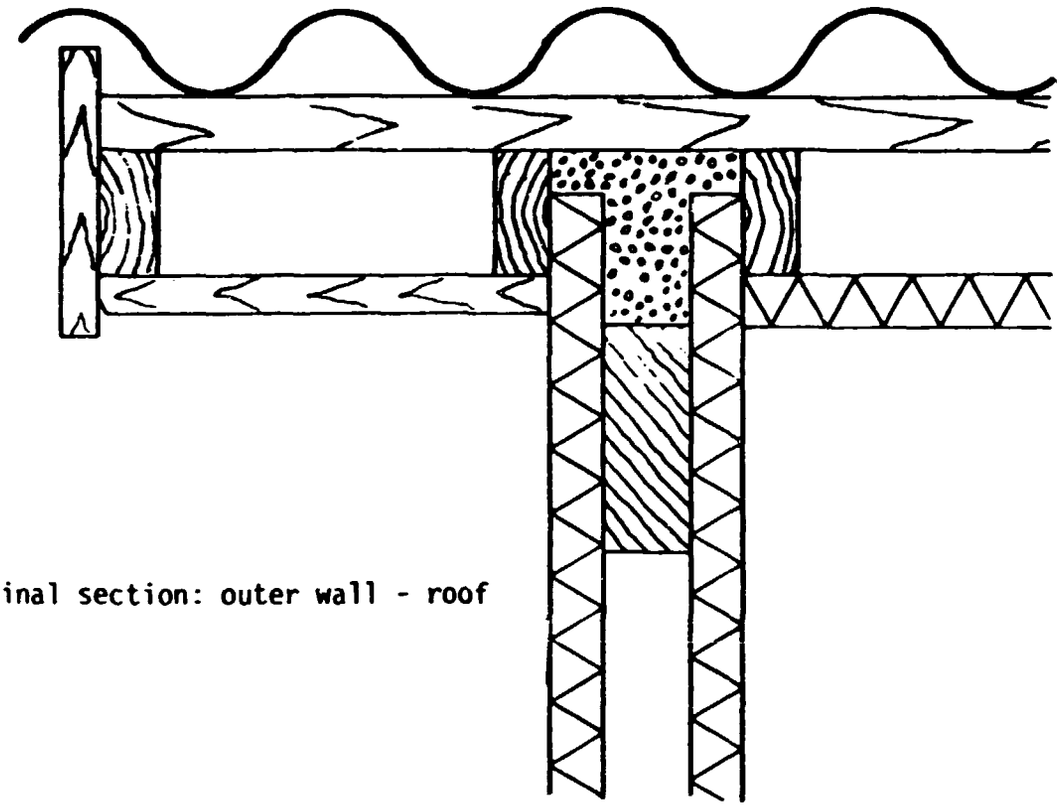
building board

concrete

timber

timber

ANNEX 9/13



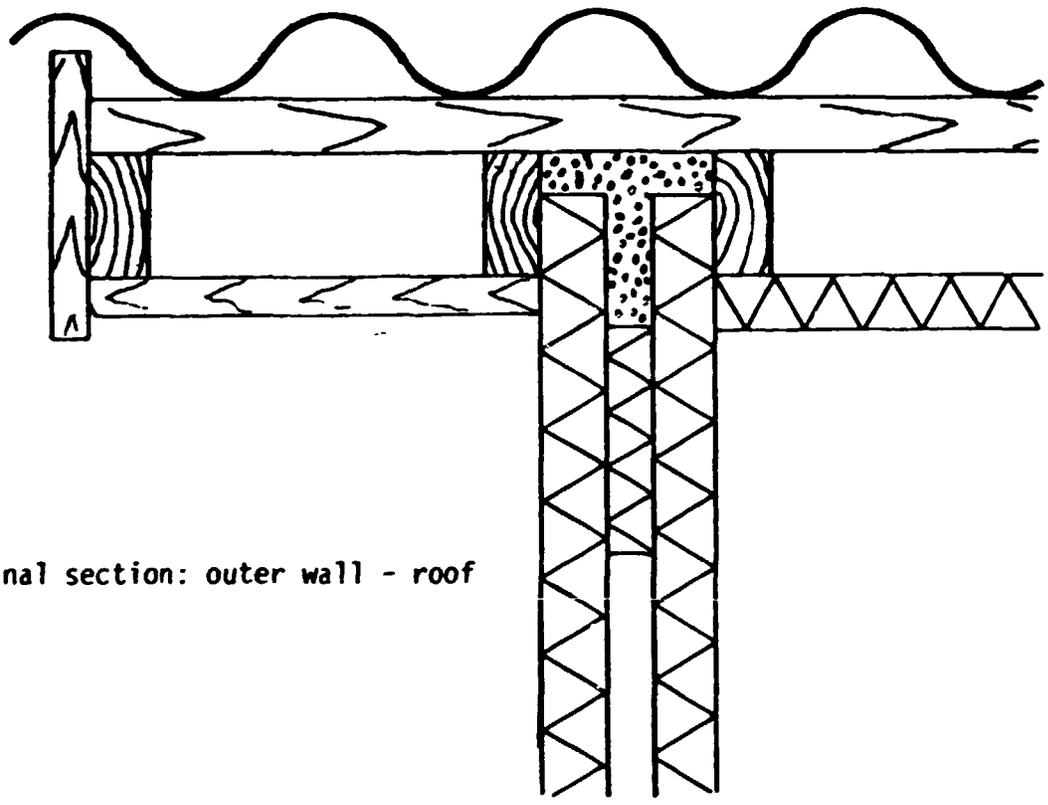
Longitudinal section: outer wall - roof

building board

concrete

timber

timber



Longitudinal section: outer wall - roof

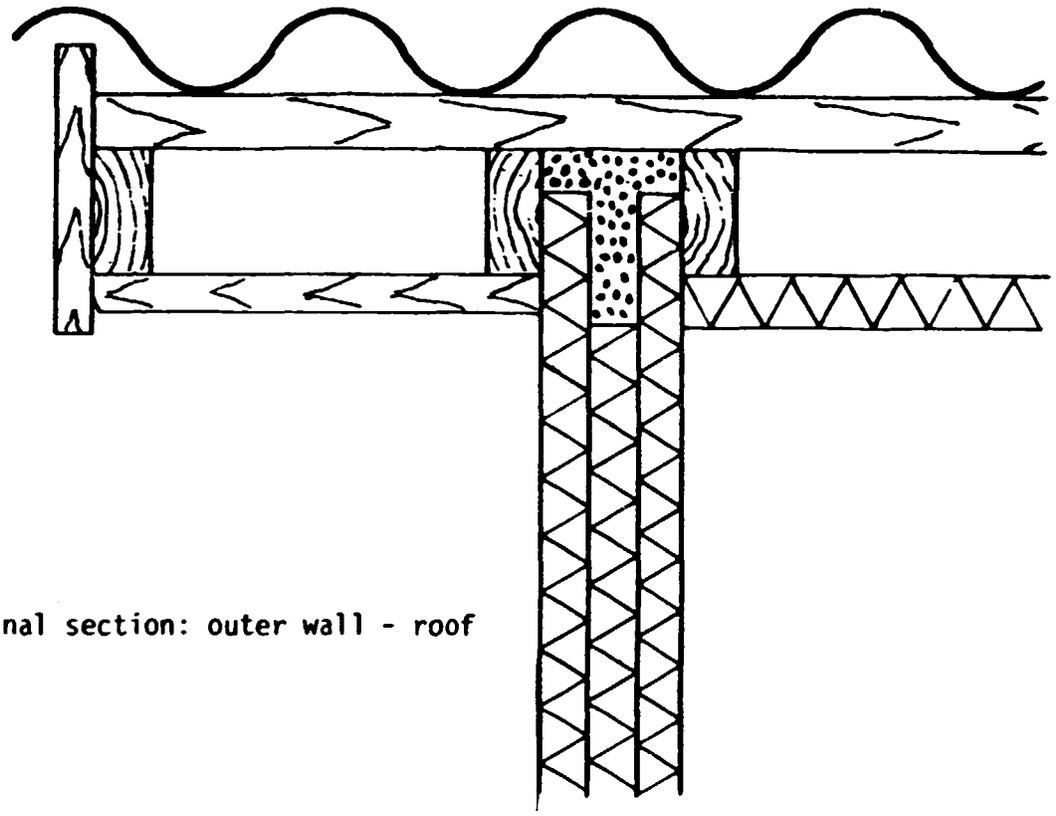
building board

concrete

timber

timber

ANNEX 9/15



Longitudinal section: outer wall - roof

building board

concrete

timber

timber