

world consultation on wood based panels

consultation mondiale
sur les panneaux dérivés du bois

consulta mundial
sobre paneles a base de madera

New Delhi, India, 6-16/2/1975

FO/WCWBP/75

EVENING
LECTURE

WOOD WOOL CEMENT BOARDS
USED FOR LOW COST HOUSES
AND OTHER APPLICATIONS

by

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wood wool cement boards used for low cost housing and other applications

Raw materials:

Wood wool cement boards are made from long woodfibres and Portland cement. The fibres are 1–5 mm wide and from 0,2–0,5 mm thick, depending on the application of the boards.

For acoustical and decorative purposes, the fibres are comparatively narrow but thick in section.

For insulation purposes the fibres are wider and thinner in section.

From one cubic meter of second class wood, three cubic meters of wood wool cement boards can be produced with a density of about 400 kg per cubic meter, however for certain purposes the boards are made denser and somewhat heavier.

Until recently it was believed that only a few kinds of wood, such as pine, poplar and eucalyptus, could be used, but now there is a development towards using also mostly all other kinds of soft wood, making use of a special treatment of the wood.

For a board of 2,5 cm thickness the following raw materials (per square meter) are used:

about	3 kg	wood wool
about	6 kg	Portland cement
about	3 kg	water (salt solution)
total:	12 kg	(wet)

After drying, this board will weigh about 10-11 kg.

Apart from cement, in some countries i.e. U.S.A., Fed. Rep. Germany, Austria and Italy, magnesite is also used as a binding agent.

Origin:

The material originates from Austria and before the last World War the product was already used on a large scale in Austria and Germany.

Expansion:

After the war, the use of the material spread over the whole world.

As an example I may mention that my company since 1960 delivered more than 80 plants to 28 countries all over the world.

With reference to the production increase I refer to the F.A.O.-paper No. 5.18, in which Professor Kollmann mentions the increase of the production in Fed. Rep. Germany from 1947–1961 from 11 million sq. metres to 39 million sq. metres.

I estimate the world production in 1974 at approximately 6 million cubic meter.

New applications:

With a few exceptions, until 1960 the product was quite poor in quality, due to its manual distribution in the moulds and lack of controlled means for dosing, etc.

After mechanical production became accepted, the number of different methods of applications increased, due to superior quality, simpler moulds and mass production allowing lower prices.

The increase in quality is proven by official tests certificates, indicating that for instance the bending strength of mechanically fabricated board reaches up to 5x the minimum requirements of DIN 1101.

Compression strength can reach up to 10x the minimum requirements of DIN 1101.

Because of the even distribution and constant quality, the boards are now increasingly used for decorative purposes and for acoustic absorption.

In this case the boards are not plastered, but spray-painted in many colours and have beveled edges.

Low cost housing:

In developing countries the material proves to be attractive for the production of pre-fabricated panels for low cost housing.

The reason seems to be that apart from the relative low price and its excellent properties, such as high insulation value, fire resistance, termite- and fungi-proof, it can be produced from locally available wood and cement, but also because it can easily be finished with mortar, or plastered or covered with other materials, such as asbestos-, aluminium-, or

plastic-sheets and roofing paper.

It can, due to its light weight, easily be man-handled, so no cranes are necessary.

Also it can be nailed or screwed onto frames of different materials, sawn and painted.

For low cost housing three principal construction methods are used:

1. The boards are nailed or screwed on both sides onto a timber or steel frame and after that finished with one of the materials mentioned before.
2. The boards are furnished with steel channels (see Exh. A-12). This steel also gives structural strength to the house.
3. Sometimes sandwich-panels are used, having a pre-screeded mortar finish on its surface and longitudinal channel-shaped openings on its sides to enable concrete-pouring for framing. This concrete can be reinforced with steel bars (see Exh. A-20-21-22).

The system to be chosen is dependent on the presence of termites and the availability and price of timber and steel, etc., but also on the climatic conditions.

The same applies for the choice of system for covering the walls.

Usually the walls are plastered with mortar on the outside and mortar or gypsum on the inside.

The roof can be constructed from steel channel reinforced wood wool cement boards, covered with roofing paper or shingles.

Another type of roof consists of a wood or steel construction covered with different materials, such as corrugated asbestos, corrugated steel-sheets, corrugated aluminium-sheets or tiles.

In this case the roof should be insulated for instance with wood wool cement boards, connected to the roof construction on the inside, or a suspended ceiling should be installed, especially if the roof is of a saddle-type.

Special applications:

In several countries special applications have been developed which differ very much from country to country.

It is very interesting to notice that products being very successfully used in one country, will not be sold at all in another country, in which another special application is popular.

However, in many countries one observes a parallel development from plastered to *unplastered ceilings* for increased acoustic value, whereas in most countries *roofing* is very popular with all kinds of shapes, compositions and dimensions of boards.

Further, because of its insulation value in certain countries exists an increased interest to use it as *permanent shuttering* of concrete walls, mainly for high rise apartment buildings and cooled or heated factories, warehouses, etc.

For instance a 12 cm concrete wall poured in between two wood wool cement boards of 5 cm thickness each, after plastering or covering with sheet material, will have an insulation value equal to a 102 cm brick wall (see a.o. F.A.O.-paper No. 5.18)

Several systems for permanent shuttering have been developed.

Most of them make use of plain boards being assembled on site to form the shuttering using spacers of steel wire.

During assembling and concrete pouring the shuttering boards are supported by a provisional timber construction.

Other systems make use of a wood wool cement board on the outside and a gypsum board or a sandwich board from gypsum and wood wool cement on the inside for easier plastering.

According to the Thermoklith-system, elements of 25 cm high and 1 meter long, are pre-fabricated into rigid light-weight elements which can be placed upon each other without any support and then filled with concrete.

For finishing these walls, several systems exist, such as plastering with gypsum on the inside and mortar

on the outside, or covering the walls on the inside with gypsum boards and on the outside with Eternit boards (Glasal), aluminium-sheets, plastic-sheets, tiles, etc.

In some countries so called *sandwich boards*, consisting of a styrofoam core and two layers of wood wool cement, are increasingly popular, especially where high insulation values are necessary.

Also this type of board is used to give styrofoam boards a fire protection and more rigidity.

In some countries wood wool cement boards are reinforced on their longitudinal sides with male and female U-type steel channels to give them structural strength for a free span up to 6 meter or even more.

In other countries, because of their low price, low weight and acoustic property, wood reinforced roof boards are very popular.

In exhibit A, you can see several types and shapes of elements incorporating wood wool cement material for different applications.

On hand are several slides, made in different countries.

I will show buildings and explain construction details of low cost housing and other applications.

The slides will show in particular:

1. low cost houses
2. roofing
3. permanent shuttering
4. ceilings
5. decoration
6. acoustic purposes
7. fire protection

Often the purpose of application is a combination of requirements.

For instance a roof of wood wool cement boards is light in weight, economic in price, insulates against heat and cold and absorbs noise.

Durability:

Because the wood wool is petrified by the cement, it has a very long life.

Boards produced 50 years ago are still in good condition.

A test house, built in the Netherlands in 1945, has been used as a house for a long time and is now being used as an office.

In exhibit B, the main properties of the material are listed.

Future prospect:

In view of increased demand for comfort and the existing and expected governmental instructions to reduce noise in schools, offices, etc., more and more wood wool cement boards will be used as suspended ceilings and as roofs on warehouses and factories. Further it is expected that permanent shuttering will obtain a larger share of the market, because of its energy saving and added comfort and moreover because certain countries have already prescribed larger insulation values for buildings.

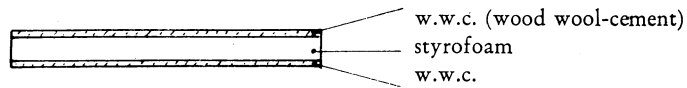
Finally, in view of the tremendous demand for low cost houses and the possibilities of producing durable panels at low cost from locally available raw materials, an increased application of wood wool cement products can be expected.

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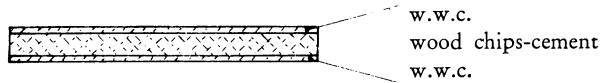
special products of wood wool cement

Exhibit A

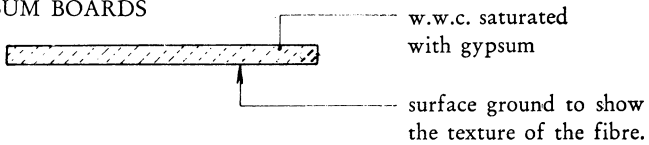
- 1 SANDWICH BOARDS
light weight with
increased insulation value



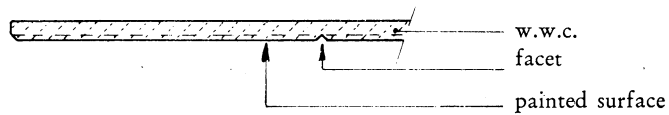
- 2 TRIPLO BOARDS
with a core of wood chips-
cement



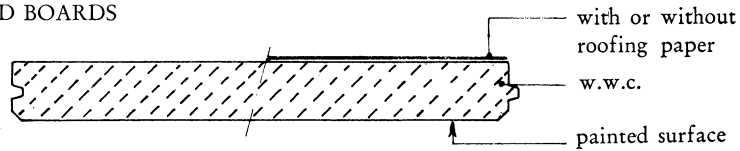
- 3 WOOD WOOL CEMENT - GYPSUM BOARDS



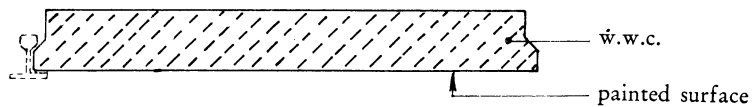
- 4 FACET BOARDS
facets dividing the boards
in 1, 2 or 4 faces



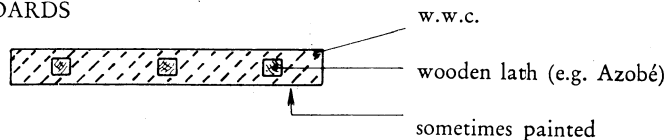
- 5 TONGUED AND GROOVED BOARDS
used as roof boards,
transversal on the
purlins



- 6 BULB T SYSTEM
roof boards
on bulb T profile
steel



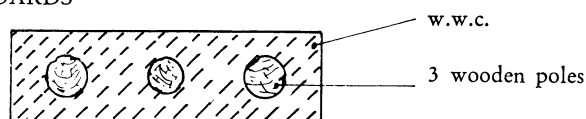
- 7 WOOD REINFORCED ROOF BOARDS
(1 m span)



- 8 WOOD REINFORCED ROOF BOARDS

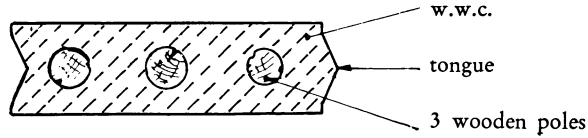


- 9 WOOD REINFORCED ROOF BOARDS
(2 m span)



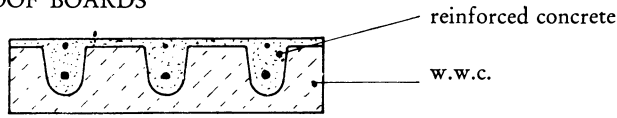
10 WOOD REINFORCED ROOF BOARDS

with tongue and groove



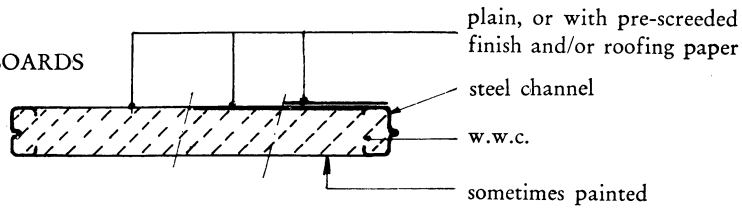
11 CONCRETE REINFORCED ROOF BOARDS

with mortar finish



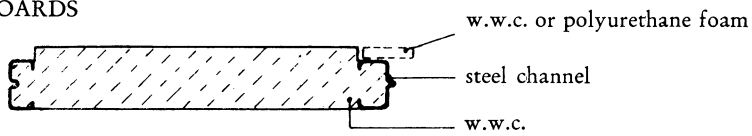
12 STEEL CHANNEL ROOF BOARDS

(2-4 m span)



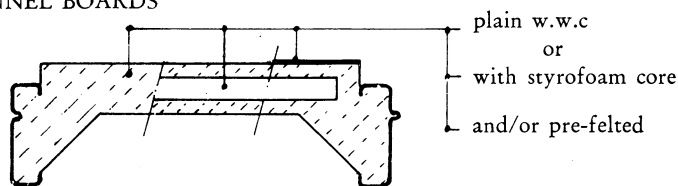
13 STEEL CHANNEL ROOF BOARDS

with rebate and infill
(for humid conditions)



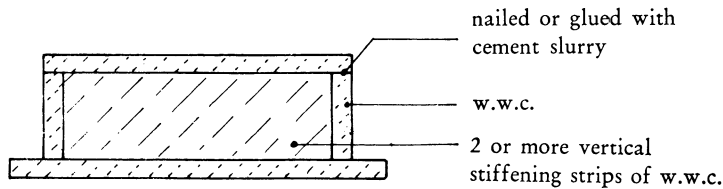
14 LONG SPAN STEEL CHANNEL BOARDS

(4-6 m span)



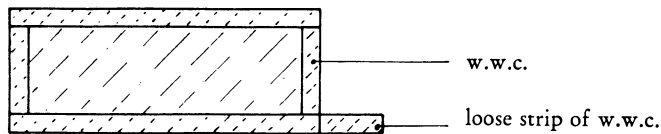
15 FLOOR UNITS

(assembled)

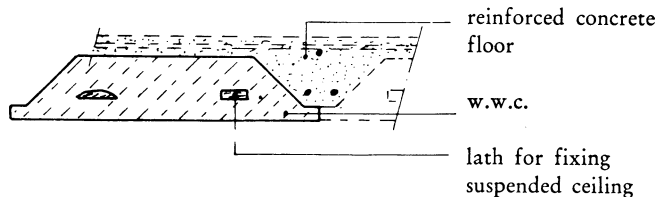


16 FLOOR UNITS

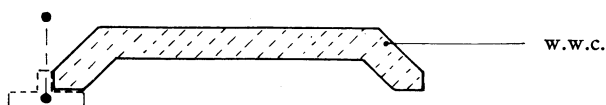
(assembled)



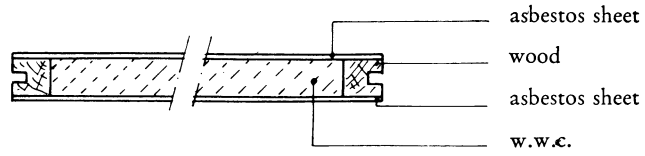
17 FLOOR UNITS



18 FLOOR UNITS

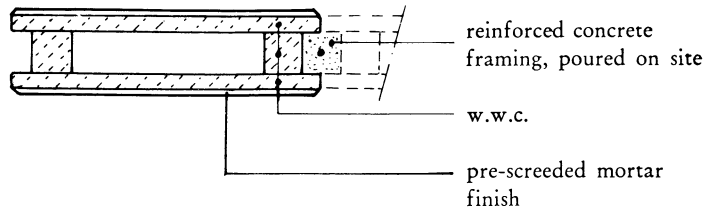


19 WALL PANELS



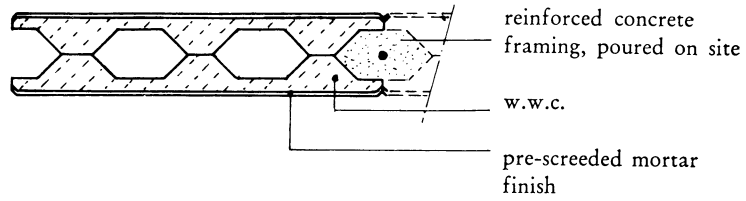
20 LOW COST HOUSE ELEMENTS DAVIDOVIĆ SYSTEM

(assembled) with pre-screeded finish of mortar

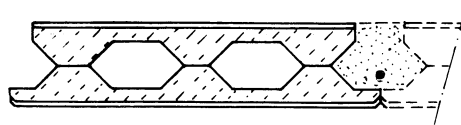


21 LOW COST HOUSE WALL ELEMENTS ELTENIT SYSTEM

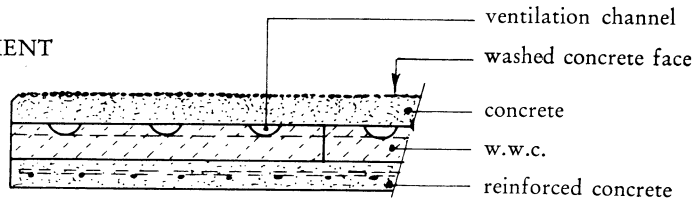
with pre-screeded finish of mortar



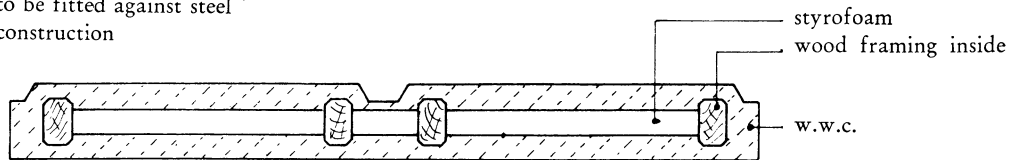
22 LOW COST HOUSE ROOF ELEMENTS



23 INSULATING FRONT ELEMENT (ventilated)



24 WALL ELEMENTS (3-M SYSTEM) to be fitted against steel construction



25 THERMOKLITH ELEMENTS for permanent shuttering

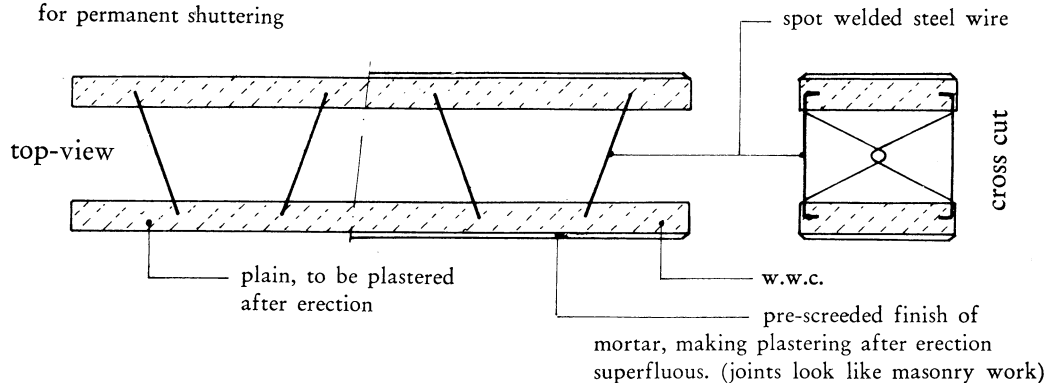


Exhibit B

Specification of properties of mechanically manufactured wood wool cement boards.

Specific gravity:

light boards for insulation only:	360 kg/m ³
denser boards for roofs and permanent shuttering:	450 kg/m ³

Insulation value:

light boards for insulation only:	$\lambda = 0,06$ kcal/mh [°]
denser boards for roofs and permanent shuttering:	$\lambda = 0,07$ kcal/mh [°]

Bending strength:

20–30 kg/cm²

Sound absorption:

for a suspended ceiling of 2,5 cm boards

frequency:	250	500	1000	2000	4000	c/s
absorption coefficient:	0,67	0,48	0,44	0,72	0,73	

Sound transmission:

Resistance of a plastered wall of 5 cm w.w.c. boards:	36–40 dB
Resistance of a plastered double wall with air space in between:	53–57 dB
Resistance of a wall of permanent shuttering with a core of 12 cm concrete:	54–56 dB

Fire resistance: (tests according to BS 476)

- 5 cm boards – 1 hour resistance
- 10 cm boards – 2 hours resistance

Water resistance:

- emersed in water for 10 years : no deterioration
- being in the ground for 30 years: no deterioration

Fungi resistance:

- resistance against dry rot and fungal growth
- and also impervious to all forms of vermin

Termite proof:

- termites do not attack the product

Workability:

- wood wool cement products may be sawn, nailed or painted and can easily be plastered with mortar or gypsum



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