Promotion of Eco-building Technologies, small Polygeneration and Renewable Heating & Cooling Technologies for Buildings

ProEcoPolyNet Technology Profile

Non-massive structures for buildings

Description of technology

Non-massive structures have been developed to give an important contribution in controlling environmental internal conditions in buildings, not only in winter but even in summer conditions, offering to designers and architects the possibility to apply a different and lighter way of construction and to obtain important results in energy saving.

These systems consist of a layer structure composed of a cement board outside and gypsum plasterboards inside, with in-between layers of insulating materials which can be of a different nature.

For example, in order to get a good cooling-load control performance, it is necessary to use insulating materials with quite high values of density, such as wood wool, high density mineral wool or high density wood fibre. Moreover, wood panels can be applied, as bearing or closing structure.

For some typologies, external rendering with plaster or wood staves can also be used.

Some examples are detailed in the annexed tables.

Technology Application

Non-massive solutions can be applied instead of traditional walls when thermal insulation high performances associated with a good summer behaviour are required.

The most important factor to take into account for the application of non-massive walls technology is the very accurate and correct design of the internal layers of the structure, mainly because of the presence of several layers made with insulating materials. The correct internal design of the structure is to be considered indispensable to prevent the risk of interstitial condensation. In fact, control of heating and cooling load is strictly connected with hygrothermal performance of the building.

In general the use of this technology is not recommended in buildings with particularly wet internal design conditions, in absence of an active humidity control system.

Moreover, it is more suitable for climates with very cold winters and hot summers.

Energy Performance

The main parameters to evaluate energy performances of a wall system (in winter and summer) are the following:

► **Thermal Transmittance (U)** the heat power per surface area that is transmitted in/out of the building due to temperature difference per each degree [W/(m2K)]. Low values are important to reduce thermal losses in winter season. (See values in the annexed tables)

► **Time Shift** (ϕ) period of time between the maximum amplitude of a cause and the maximum amplitude of its effect. In this case period of time between the maximum value of external surface temperature and the maximum value of internal surface temperature. (See values in the annexed tables)

► **Decrement Factor** (fa) ratio of the modulus of the periodic thermal trasmittance to the steady-state thermal trasmittance U. (See values in the annexed tables)

Location and use

From an architectural point of view, advantages derive from the possibility to realize complex shapes, with large flexibility for the designers. This is the reason why these structures are mainly used in tertiary buildings with particular features (e.g.: curved walls, integration with completely glazed facades, etc.).

Check criteria

► ***Favourable Factors:***

High buildings

Buildings with complex shapes

Cold climate conditions in winter, hot climate conditions in summer.

Very accurate design of internal distribution of layers in the structure.

Normal internal hygrothermal conditions (45-65% UR)

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► ***Unfavourable Factors:***

Very hot climate conditions in summer

Small buildings

Wet internal conditions (UR > 65%)

► ***Combination with other technologies***

Control of summer internal conditions mainly depends on the quality of glazing surface. So, the use of solar control glazing and adequate shading devices is strictly recommended to obtain the best performances.

Market situation and barriers

Main barriers, especially in Southern European Countries, could be represented by construction culture issues. In fact, most designers can't accept to choose a non-traditional solution.

Another barrier-factor could be the cost of these solutions, that in many cases are higher than more traditional materials (i.e. masonry blocks).

However, they allow more flexibility and give to designers the possibility to employ bio-materials. Moreover, they are easily available on the market and can be easily transported.

Typical cost indicators

Investment: medium

Operating costs: medium

Operating maintenance costs: low

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Main benefits

- Improved Thermal insulation
- More architectural flexibility
- Good control of summer cooling load
- Reduced weight of total structure

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ProEcoPolyNet is a **Net**work for the **Pro**motion of RTD results in the field of **Eco**-building technologies, small **Poly**generation and renewable heating and cooling technologies for buildings.
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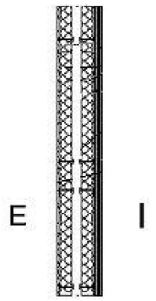
SIXTH FRAMEWORK PROGRAMME

Annex

Tables: **ENERGY PERFORMANCE OF NON-MASSIVE STRUCTURES**

In the tables below three examples of non-massive structures are reported, with their values of thermal transmittance, time shift and decrement factor (see definitions in the paragraph "Energy performance"). Each type of structure can be realized using different kinds of materials as listed in the table.

NON MASSIVE STRUCTURES
Type 1



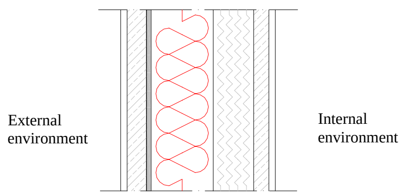
Stratigraphy
- Cement board
- INSULATING MATERIAL *
- Air layer
- INSULATING MATERIAL *
- Double Gypsum Plasterboard

* insulating layers change their thickness and kind of material as reported in the table

VARIABLES

V1	cm	U	ϕ	*fa*
Wood wool	7,5			
Wood wool	5	0,56	9h 9'	0,3677
V2	cm	U	ϕ	*fa*
Mineral wool	10			
Mineral wool	7,5	0,196	5h 18'	0,7588
V3	cm	U	ϕ	*fa*
Wood wool	10			
Wood wool	7,5	0,434	12h 35'	0,1939
V4	cm	U	ϕ	*fa*
Wood wool	7,5	0,351	7h 36'	0,472
Mineral wool	6			
V5	cm	U	ϕ	*fa*
Wood wool	10	0,4313	8h 35'	0,3704
Mineral wool	3			

NON MASSIVE STRUCTURES
Type 2

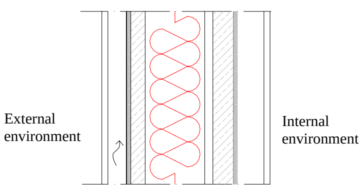


Stratigraphy
- Plaster
- Wood wool 3,5 cm
- Transpirating membrane
- INSULATING MATERIAL *
- Wood panel
- Wood wool 3,5 cm
- Plaster

VARIABLES

V1	cm	U	ϕ	*fa*
Wood fibre (45 kg/m³)	10	0,21	14h 13'	0,13
V2	cm	U	ϕ	*fa*
Hemp fibre (30 kg/m³)	10	0,215	13h27'	0,142
V3	cm	U	ϕ	*fa*
Mineral wool (50 kg/m³)	10	0,199	13h25'	0,140

NON MASSIVE STRUCTURES
Type 3



Stratigraphy
- Cement board
- air layer
- Transpirating and reflecting membrane
- Wood wool 3,5 cm
- INSULATING MATERIAL*
- wood panel
- wood wool 5 cm
- Reflecting moisture barrier
- air layer
- Gypsum Plasterboard

* insulating layers change their thickness as reported in the table

VARIABLES

V1	cm	U	ϕ	*fa*
Mineral wool (50 kg/m³)	10	0,172	13h23'	0,111
V2	cm	U	ϕ	*fa*
Mineral wool (50 kg/m³)	12	0,156	13h46'	0,103
V3	cm	U	ϕ	*fa*
Mineral wool (50 kg/m³)	16	0,133	14h35'	0,09