



Timber buildings and thermal inertia: Open scientific problems for summer behavior in Mediterranean climate[☆]



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ABSTRACT

In a climate that features warm winters and hot summers, the houses that perform better are heavy houses. Heavy stone or masonry walls work as thermal masses that guarantee winter comfort and absorb thermal loads in summer. The real estate market is now putting pressure and emphasis on quality of buildings and building components performance control. The best way to achieve them is through industrial products and prefabrication. Wood technology in construction is well received by the market. It is very precise, thanks to CNC machining and offers good performance at seismic forces. The only issue with wood construction is its lightness: it is useful for transportation and assembling, but it has mass values far from traditional masonry. The Team MED in Italy for Solar Decathlon 2012 tested in the prototype for Madrid a new wall stratigraphy where, aside from insulation panels, heavy materials put in a layer once the house was assembled. This solution gave a mass value that is nearly double the value of a normal framed wall, and therefore very close to a traditional masonry wall. At the same time, this also increases the acoustic performance, by solving a problem that is typical of lightweight construction.

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1. Introduction

“MED in Italy” team, composed by the University of Roma TRE, in collaboration for the interior design with the Sapienza University of Rome, and for the thermal tests with the Free University of Bozen and the Italian Fraunhofer Institut, designed, developed, and run out the homonymous house prototype. The results set out in this article refer to research activity carried out by the “MED in Italy” team at the Department of Architecture of Rome during 2011–2012 (see Fig. 1).

The house, primarily passive, takes the energy it needs for comfort supply and appliances functioning from the sun, thanks to an efficient PV shell that shades the building avoiding overheating in summer. An innovative HVAC system guarantees the internal comfort without increasing consumptions. Glue laminated timber from certificated forests PEFC (that means from grow and cut controlled forests) builds up the structure of the house.

The “MED in Italy” name synthesizes the concept of the entire project: Mediterranean in Italy, willing underline a correlation

between the Italian ability to do (made in Italy) and the typical Mediterranean climate. This led the team to study the house behavior in relation not only with a cold climate but also with a high temperature climate developing efficient solutions for both.

This consideration becomes more important if we consider that, due to the global warming, many more countries will be involved in the hot summer problems.

2. The Italian real estate market

The entire world has yet recognized that the earth ecosystems are currently at a critical stage. They are already severely damaged and human activity currently leads to irreversible losses of fundamental ecosystem functions. The construction sector has the largest single share in global resource use and pollution emissions.

Far from being just an economic phenomenon, the construction business reflects and is influenced by variables and trends taking place at many levels (demographic, legal, social, cultural, technological, etc.). From a supply side point of view, construction is a business and the main target pursued by operators is to carry on activities in the most effective (meeting pre-fixed targets) and efficient (maximizing profits) way. From a demand side point of view, however, constructions are often endowed with meanings and values that go far behind their functional features, being associated by people to a shelter, a place to rest, for the family.

[☆] This document is a collaborative effort.

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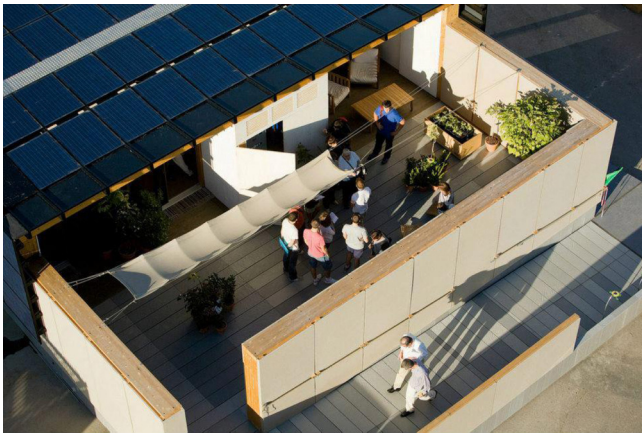


Fig. 1. The MED in Italy house prototype in Madrid.

At the consumer level, due to the very recent changes provided by the austerity policy, Europeans are modifying their behavior turning from traditionally – not green – to more conscious behavior. The indirect effect of such changes consists in the spreading of more social and green behavior aimed first at saving money, but consequently at preserving the environment.

In such a context, projects that find sustainable solutions for housing represent important factors for improving both the environment condition and the standards of living of the population.

This renewed interest in efficient energy buildings, where it is possible to live healthy with reduced costs, is demonstrated by the increase of timber structure buildings in the real estate building sector. Although from 2008 to 2011 investments made in the construction sector have decreased by 17.8%, which is indicative of a very serious crisis, the market for wooden houses (excluding houses built as after the earthquake of 2010 in Abruzzo) is constantly growing in contrast to the market for buildings made of other materials, going from a market share of 0.50% in 2006 to an anticipated 4.50% expected in 2015 [1] (see Figs. 2 and 3).

2.1. Thermal inertia for a new real estate market of timber buildings

Despite the great success of timber constructions in Italy, our opinion is that, in warm temperate climates as Mediterranean one, these solutions can meet in the long run frustration for users. This will be mostly due to the fact that lightweight structures behave in an unsuitable way in summer, failing to dissipate the heat that has been accumulated. We also know how difficult it is for a building

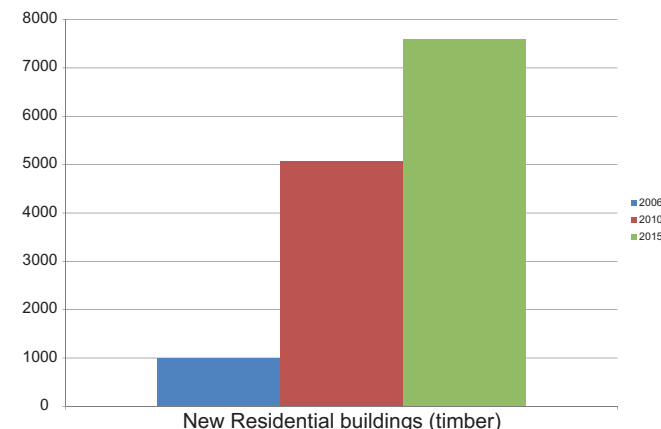


Fig. 2. Trend of new timber residential buildings 2006–2015.

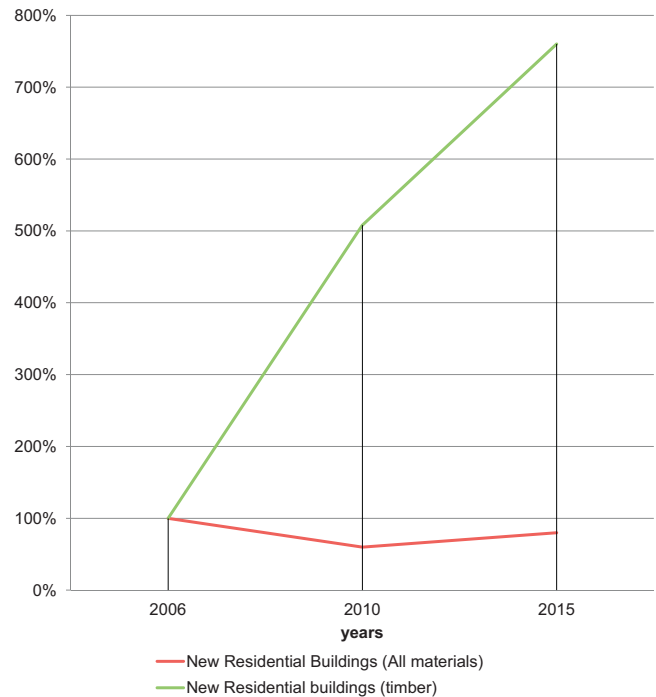


Fig. 3. Trend of new timber residential buildings base 2006 = 100%.

to acquire structures that can vary according to the fluctuation of temperature recorded on a summer day. Therefore our belief is that a layer of mass could be added in the stratigraphy of a wooden building. This mass can act as a thermal stabilizer for indoor climatic conditions, providing a new concept of sustainable building. The identification of the key success factors at the basis of our value proposition arises from the following considerations:

- the prefabricated structures, being more reliable for the respect of time and costs than the traditional heavy wall structures, which are distinctive of Mediterranean vernacular, are now more and more chosen;
- the greatest part of sustainable houses is projected and built to maximize comfort and savings of households, as well as minimize environmental impacts.

The target of the majority of companies operating in the green building sector is people living in the Central and Northern regions of Europe. Far more limited seems to be the offering of houses designed for warmer climates, such as Southern European areas, where it is important to optimize the building passive behavior for the intermediate and summer seasons. This requires special attention to the management of their internal loads in order to improve the free contributions of energy by reducing the need of air conditioning system. In this framework, the light structure of timber prefabricated buildings, with its very low mass, is a major problem for the market trend of export.

Consequently in multi-layer walls to weight the inner layers of the envelope can help to neutralize the excess of internal heat loads, optimizing the needs of thermal HVAC system throughout the year. Such positioning could be strategically exploited to appeal contractors willing to widen their product lines, entering a new real estate market.

3. The MED in Italy envelope solution

MED in Italy, the housing prototype that took part to the Solar Decathlon International competition, and was awarded with the

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