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Honors theses

Wood in sustainable buildings

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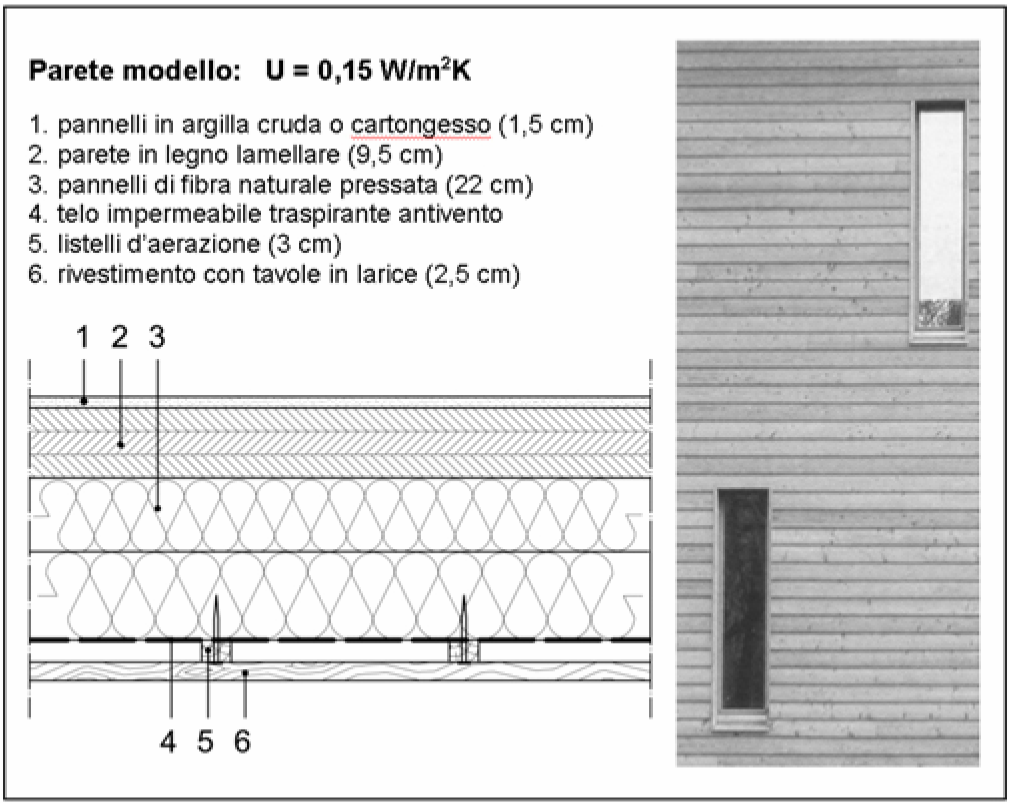
In the current European architectural context there is a growing attention to the problems of environment and energy. Materials that are new or partially new (re-elaborated from the tradition) are then studied and promoted in order to obtain more sustainable buildings. Wood, in particular, when applied as a structural element, is considered a very good tool to induce a decrease in the so called "greenhouse effect" (the CO_2 in the atmosphere adheres to the wooden fibres eventually getting imprisoned in them) and its application both in public and private building is thus supported.
Moreover recent studies on environmental, ecological, biological and technological features of this resource, show that a further utilisation of wood in architecture is possible and recommended not only from the point of view of the physical and mechanical performances but also from that of the world ecosystem equilibrium, as the rate of utilisation of wood is far inferior than the rate of its re-establishment (the wood is highly renewable).
Anyway these characteristics of the wood lead to behaviours that depend on the adopted building technology. In history there are many building systems adopting the wood as a structural material: through a very interesting evolutionary process, traditional systems, such as log houses and fakhwerk have been progressively renewed and adopted to the local climatic, technological and cultural specificities. For instance, a revolutionary change occurred in America in the first decades of the XIX century, when the first industrialised building systems, i.e. the "Ballom Frame" and "Platform Frame" systems, were introduced to satisfy the European colonialists' need for a faster, lighter and more flexible way of building. From these systems and other that come later (for example the system of structural wood boards with varying degrees of prefabrication) developed the systems that are now the most commonly applied in Europe. In particular, the stick-frame and tha solid wood b*oards* arose thanks to the simpler management of the production and prefabrication process.

Wooden building systems – img. 1

1. log houses (www.artifex-blockbau.de); 2. timber frame (AA.VV, "Il legno massiccio in edilizia", Federlegno Arredo, Milano, 2003); 3. stick-frame (AA.VV., "La nuova casa in legno dell'Alto Adige", LVH APA, Bolzano, 2000); 4. solid wood boards (AA.VV., "La nuova casa in legno dell'Alto Adige", LVH APA, Bolzano, 2000); 5. solid wood boards (www.legno-lego.it); 6. modular blocks (www.steko.it)

After introducing the different systems and their features, the physicist-techniques results of some potential opaque finishing coverings were considered and studied with respect to the criteria of a sustainable planning (i.e. with respect to the construction of energy-efficient, climate-responsive buildings).
The aim of this thesis is thus to verify and compare the thermal behaviour of some wooden walls as well as to compare them with analogous walls realised with other composed materials (concrete and bricks mixed with wood).
The comparison starts from the analysis of a realised wall in a building classified as "Casa Clima A", Casa Viedier in The Province of Bolzano, whose main structure is made by solid wood boards and with high-levels thermal results guaranteed by the heat external insulation and a well-done construction.

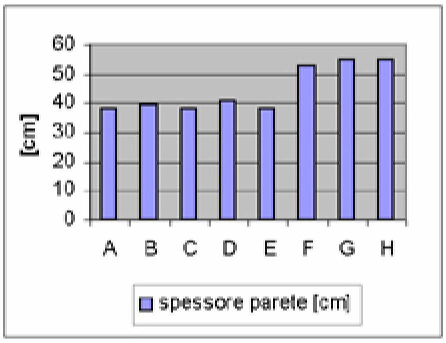


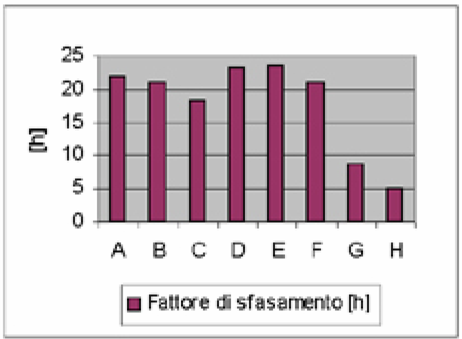
Casa Viedier wall – img. 2

(picture: AA.VV., "Turrisbabel: Legno in vista", n. 58, Notiziario dell'Ordine degli Architetti di Bolzano, Bolzano, 2003)

Assumed that all the considered pareti had the same winter performances (the same U-value and verified hygrometric behaviour), the comparison has been mainly conducted on the basis of their thermal summer behaviour. Results (see image 3) show that wooden building systems can offer walls with high level thermal performances both in the winter and in the summer period.

	PARETE sistema costruttivo	s [cm]	C $[kJ/m^2K]$	MF $[kg/m^2]$	f_a (-)	φ_a (h)
A	pannello a tavole sovrapposte	38,5	209	33	0,04	21,8
B	pannello a tavole sovrapposte (intercapedine impianti)	39,5	204	21	0,03	21
C	telaio e tavolato	38	154	22	0,06	18,2
D	blocco Steko	41	211	32	0,02	23,3
E	tronchi sovrapposti	38	217	22	0,02	23,6
F	pannello in pls	53	900	51	0,00	21,1
G	blocco cassero Legnobloc	55	613	40	0,00	8,7
H	blocco in laterizio porizzato	55	377	45	0,01	5





Comparison between wooden and not wooden walls – img. 3

(s: spessore; C: capacità termica; MF: massa frontale; f_a: fattore di attenuazione; φ_a: fattore di sfasamento)

Moreover, with wooden systems performances that are similar to other technological solutions are realised with a lower thickness of the walls themselves.

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