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Contemporary timber-frame construction systems in Europe

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Abstract: *Contemporary timber-frame construction systems in Europe.* In the article modern techniques of house building in Europe using timber and wood-based materials have been presented. Attention has been paid to decisive factors conditioning the increase of popularity of this type of construction. Directions of its development have been pointed out.

Keywords: Timber framing, modern technologies

INTRODUCTION

Introducing ever new technological solutions in timber construction is mainly the result of economic factors as well as widely discussed, especially in Western European countries, ecological issues. It is the effect of the Directive of European Parliament and Council of Europe concerning houses energy performance certificates (*Dyrektywa…* 2002).

Of crucial importance is also the appearance of ever new wood-based materials, which are easily adopted and utilized also in timber constructions.

Innovative solutions aim at producer's commercial success and his competitiveness, which generates higher profits. They also condition the increase in production capacity and its profitability, while its ultimate goal is the improvement of houses thermal parameters with simultaneous costs rationalization both those related to house construction and those which are incurred by the buyer during house exploitation.

1. ADVANTAGES OF TIMBER HOUSES

Choice of house construction technology is usually conditioned by economic factors, which then have the most significant impact on the future clients and are thus most plausible. Deciding on purchase of a house other aspects apart from those related to its price are taken into consideration. Significant factor constitutes the costs related to that house exploitation. Timber buildings are considered to be energy efficient that is with an increased energy standard. Therefore the costs incurred when building the house are compensated by decreased energy consumption.

When constructing buildings using timber and wood-based materials frequently the cost of its impact on environment is neglected, yet it is putting a burden on the society and has an ever more significance for a wider group of recipients. It is not only about a smaller energy consumption for heating the building but also smaller amount of energy needed during construction. From Table 1 one can state that the amount of energy needed for putting up 1 m^2 wall in a timber house is three times lower than the amount needed for the same task in a traditional technology (masonry house). It not only has an impact on lower costs of creating materials but also concerns ecological aspects. The weight of such wall is also lower which directly transfers onto the costs of transporting construction materials and as a consequence on the final house price. In case of timber houses the costs of utilizing other materials left following the period of building exploitation are also significantly lower (*Business Outlook …2006).*

Table 1 The comparison of parameters of buildings constructed in different technologies

1 m^2 of wall	Timber house	Conventional house
Energy [MJ]	271	876
Weight [kg]	71	273

Source: Lis , Mydlarz. - Business Outlook for Frame Houses in Poland 2006

2. SELECTED SYSTEMS OF TIMBER CONSTRUCTIONS IN EUROPE

Among the states which introduce the majority of innovative solutions concerning timber construction there are Scandinavian countries, Germany, Austria and Switzerland, therefore countries which pay a lot of attention to ecological aspects of building simultaneously emphasizing economic aspects of each investment. Lowering the cost of house construction was the main reason for creating in Switzerland the system of self-assembly prefabricated houses. Due to a possibility of self-assembling a building, separate construction elements form small construction modules of the following basic measures: length 640 mm, height 320 mm or 240 mm and width. 160 mm (www.steko.de 2011).

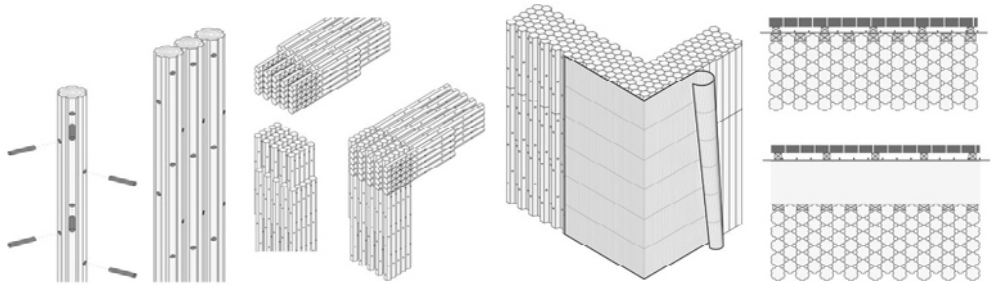
Picture. 1 Timber module used for house self-assembly and house construction using the system designed by Steko company.
Source: *www.steko.de* 2011

A detached house constructed from such elements may be put up in 2-3 days. There is no need for mortar or cement. Modules on offer are hollow which allows for electric installation and thermal insulation. Recommended form of insulation is wood wool. Investors when building a house may use the assistance of professional companies which offer help with both actual construction and supervising the whole investment (*Pro fertighaus* **2000**).

Another example of a system which uses large panels measuring 2,45 m in length and 5 m in height is lignotrend wall system. It allows for manufacturing size-stable, non-flexible and stress-free wall elements. However the system requires assistance of a company specializing in buildings assembly, which unfortunately increases the costs of its construction, yet adequately prepared elements guarantee construction of high quality and long durability.

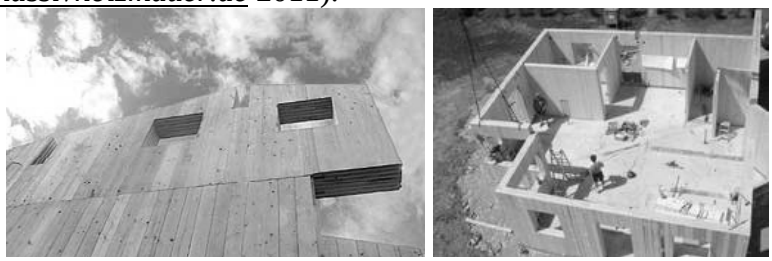
Picture. 2 House construction using lignotrend walls.
Source: *www.baudoc.ch.*- 2009

Another solution used in Germany is so called – Palisadio system where for wall building 12-sided solid wood components manufactured from round small-wood boles or square-cut timber beams of 72 mm in diameter and 12% moisture are used. A large number of solid-wood components are bundled in individual, multilayer elements and bound together with natural wood fastenings without the use of any metal or glue. Standard wall has five layers of thickness and its heat transfer coefficient U = 0,27 W/m^{2}K, however in combination with modern insulation materials may even achieve 0,2 – 0,11 W/m^{2}K. For protection against wind, moisture and other detrimental factors insulating layer of protective foil is being used (*www.palisadio.de – 2011).*



Picture. 3 Construction elements in Palisadio system
Source: *www.palisadio.de* – 18.06.2011

Relatively new technology used in Austria and Germany is MHM (*Massiev-Holz-Mauer*) – solid timber walls. Wall produced in this system consists of a few layers of boards pressed together in criss-cross manner. Multi-layer construction allows for erecting walls of about 34 cm in thickness. Due to timber usage such wall has very good insulation parameters additionally improved by milling small groves on the surface of the boards. It is highly ecological solution which from 2005 was launched into production in Germany. Class of heat resistance for MHM of 20,5 cm in thickness amounts to F90B. Detached house built in this technology is erected on site over 1-2 days with and accuracy of 1 mm, for dry ready-made elements (*www.massivholzmauer.de* 2011).



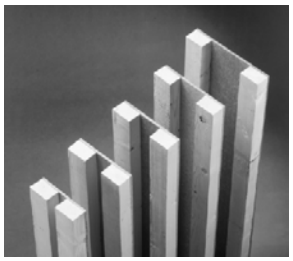
Picture. 4 Wall elements MHM
Source: *www.massivholzmauer.de* – 18.06.2011

In Austria a new method of sawing timber into squared logs in cone shape was designed what allows for maximum usage of the length of a log and decreasing loss at sawing from 50 -70% to 5-10%. In this system called Wolf system, load-bearing timber constructions are used where squared logs are joint with nailplates. As a result of sawing timber into cone shape and its rational placing within a construction (adjusting to current loads) positive economic effect is achieved *(Mielczarek 2009).*

While the basis of Norwegian Masonite system are I- section logs and posts where flanges are made of timber and webs from plywood or OSB (oriented standard board) depending on their tasks and location within the structure. They are produced using own and patent technology. Depending on the size and section the beams are used for roofing as well as wall strengthening against wind and to form beam structure. While posts have to carry the

load between roofing trusses and walls and between walls and foundation(*Masonite Building… 1998).*

Picture. 4 Joining the rafters resting on purlin in Masonite system



Picture. 5 Elements of Masonite sytem

Source: Masonite Building System British Board Agreement, Certificate Nr 98/3514/C.

Yet another solution is Quick module system. It is a system of constructing houses from beams which was designed in Sweden. Beam has an interior made of styrofoam onto which from both sides Masonite panels are glued. From the outside the panels are made of pine or spruce 20mm thick panels. From the inside the panels have trapezes notches and their front edges are equipped with joggle joint. Those elements are really light (50 N/m), which to a great extend makes the construction process easier (*Przegląd budowlany 1998).*

3. DEVELOPMENT TRENDS IN TIMBER CONSTRUCTION

The introduction and improvement of timber construction systems in line with the resolutions of EU Directive 2002/91/WE concerning buildings energy performance certificates are focused on energy efficient building. Low energy consumption of energy efficient houses is possible to achieve not only due to the application of modern construction materials, used in traditional building sector. Those parameters may also be reached by the application of new technological solutions in timber construction, using both timber as well as the most modern wood-based materials. Energy consumption in case of energy efficient building amounts to 50-70 kWh/m^2 per year while a new building erected using traditional technology which meets the current norms annually uses approximately 100 kWh/m^2 and older residential buildings use 145-195 kWh/m^2 per year *(www.tadeks.pl 2010).*

Modern solutions in timber construction meet ecological requirements and are characterized with reduced CO_2 emission. In accordance with European experts timber house reduces this emission by approximately 10 tonnes, which in case of 10% share increase of this type of construction on the European market could reduce CO_2 emission by 1,8 million tonnes, which constitutes approximately 2% of the total emission in Europe (*Drewno a zmiany* **2005***).*

CONCLUSION

Modern material and technological solutions used in timber construction very often differ from the so far ruling trends of erecting buildings. Mainly ecological and economic factors which condition the directions of development in residential building have significant impact on the image and technological advancement of erected buildings.

Buildings made with the application of modern timber technology frequently do not differ visually from traditionally built houses. Current systems of erecting houses confirm that the basis of their construction is the utilization of timber and all wood-based materials. Due to that the interest of investors in timber construction grows which results in setting up new companies specializing in building house with the application of this type of technology. That leads to an ever stronger competition which forces the constructors to create ever more innovative systems.

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Streszczenie: *Współczesne systemy budownictwa drewnianego w Europie.* W pracy przedstawiono nowoczesne techniki budowy domów z wykorzystaniem drewna i materiałów drewnopochodnych w Europie. Zwrócono uwagę na czynniki decydujące o popularyzacji tego budownictwa. Wskazano kierunki jego rozwoju.

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