
Issues Related to Durability and Protection Affecting the Acceptance and Use of Engineered Wood Composites in Europe

Mark Hughes and Jerrold E. Winandy

Abstract

Engineered wood composites (EWC) offer significant potential in applications in the built environment, ranging from domestic dwellings to bridges and public buildings. Nevertheless, EWCs, which include products such as glulam, laminated veneer lumber, oriented strand-board, and plywood enjoy a relatively small market share of total wood-based material production and consumption in Europe at the present time. After briefly outlining the current use of timber in the built environment within Europe and examining trends, this paper will explore the potential for EWCs in the European Union. Various issues relating to the durability of EWCs and their protection will be explored and how this may subsequently impact the future growth of these materials in this sector will be discussed.

Introduction and Background

In Europe, timber framing is used mainly in domestic dwellings rather than commercial construction. Most homes are built in “bricks and mortar.” To understand why, we must respect the fact that Europe and the countries comprising the vast European Union (EU) are a diverse collection of cultures. Conversely, most residential structures in Scandinavia are timber, but relatively few are in Mediterranean countries. Many of these cultures

have a deep history of fire awareness and possibility a deeper appreciation for long-term durability than do North Americans. Accordingly, residential housing design reflects these deep-seated concerns. From an architectural viewpoint, European homeowners tend to be conservative and more likely to select classic traditional residential designs than are their North American counterparts. In contrast, North Americans seem more likely to seek unique and modern architectural residential styles and thus seem more open and accepting of newer wood composite materials in residential construction. In most of Europe, while regional differences exist, home styles follow more traditional architecture for residential construction whereas a more modernistic architectural approach for commercial or non-residential construction is considered.

Some contend that there is an EU perception of timber and wood-based products as old fashioned materials even though they are simultaneously perceived as renewable and potentially sustainable raw materials. Most Europeans seem to have a generally good perception about wood-based products, but concern about fire performance, especially of wood composites seems to limit further acceptance (Bregulla et al. 2004). While few, if any, specific regulatory barriers exist, cost and time taken to obtain certification of products is often seen as problematic (Bregulla et al. 2004). Of the technical barriers to the enhanced use of wood in general, durability was seen as the main issue (Bregulla et al. 2004).

Classic residential construction varies across Europe: France/Germany/Luxembourg, the United Kingdom, Scandinavia (**Fig. 1**). Historically, traditional French and German construction has included heavy timber post

Hughes:

Research Manager, The BioComposites Centre, University of Wales, Bangor, Wales, United Kingdom

Winandy:

Project Leader, USDA Forest Service, Forest Products Laboratory, Madison, Wisconsin, USA



Figure 1. – An example of classic residential construction in Germany (top) and France (bottom).

and beam with masonry in-fill. These structures usually have timber roof construction with tile-type shingles made of slate, ceramic, or cement. Modern French and German construction has evolved and today is often masonry block with cementitious stucco or a brick veneer cladding and a dimension-lumber roof system with slate, ceramic, or cement shingles (**Fig. 2**). Construction in the United Kingdom has similarly evolved to a point where modern residential construction possesses a look similar to North American light-framed construction but using a basic masonry frame construction rather than wood frame (**Fig. 3**). Scandinavia is the one region of the EU that has an historic acceptance of wood-frame construction (**Fig. 4**). The Scandinavians have historically been blessed with abundant forest resources and thus have long used wood in a manner similar to North America. Many believe that the origins of North American wood-frame construction had its origins in Scandinavia.

In 2001, the European woodworking industry accounted for approximately € 150 Bn (US\$ 175 Bn) of sales and employed around 1.6 million people (CEI-Bois,



Figure 2. – Some examples of modern residential construction in France showing the masonry frame (top) and stucco cladding (bottom).

2004). Of this, the furniture industry accounted for some 55 percent of sales: building components 15 percent; sawing, planing, and impregnating 12 percent; wood-based panels 9 percent; and packaging 3 percent. The production and consumption of wood-based products in Europe is still heavily dominated by what might be termed “traditional” products – sawnwood and wood-based panels (plywood, particleboard, medium density fiberboard [MDF] and oriented strandboard [OSB]). Nevertheless, there is a nascent market for so-called engineered wood products (EWPs), such as laminated veneer lumber (LVL), parallel strand lumber (PSL), laminated strand lumber (LSL), and I-beams along with traditional engineered wood products such as glulam (glued laminated timber). In Europe, while the consumption of EWPs is still small relative to the traditional wood-based products, excellent opportunities exist for these products to gain market share. Collectively, EWPs, together with some structural and non-structural panel products and wood-plastic composites can be broadly termed “engi-



Figure 3. – Some examples of residential construction in the United Kingdom from circa 15th–17th century (top left), 18th century (top right), and late 20th century with either a brick (bottom left) or render (i.e., cementitious stucco) over masonry block construction



Figure 4. – Example of classic residential construction in Finland using wood-frame construction and wood cladding.

neered wood composites” (EWCs). As the performance of some of these composites renders them potentially suitable for structural applications, issues affecting their durability will come to the fore in the future. This paper reviews some of the issues relating to the durability and protection of EWCs that may affect their use and acceptance in Europe.

Wood-Based Product Consumption

Traditional Products: Production and Consumption

In terms of the volume of the traditional wood-based products consumed, **Table 1** provides a comparison between the European Union and North America in 2004. As may be seen, sawnwood dominates consumption in both regions and when viewed on a per capita basis, the consumption of sawnwood in North America is about twice that of the EU. Some notable regional differences are also apparent with other products, reflecting differ-

Table 1. – Apparent consumption of wood-based products in 2004. (Source: UNECE/FAO statistics – Production & Trade 2000-2004.)

	European Union ^a		North America ^b	
	Absolute (x 1000 m ³)	percapita (m ³ per person)	Absolute (x 1000 m ³)	percapita (m ³ per person)
Sawnwood	99,301	0.224	148,214	0.451
Wood-based panels	54,178	0.122	67,636	0.206
Plywood	6,665	0.015	22,473	0.068
OSB	2,293	0.005	23,316	0.071
Particleboard (not OSB)	32,088	0.072	9,899	0.030
MDF	7,894	0.018	5,206	0.016

^a Includes the 25 EU member states (population ~443 million).

^b Includes the United States and Canada (population ~329 million).

ences in consumption patterns within the two regions. While the total consumption of wood-based panels was similar in both regions, the absolute and per capita consumption of structural panel boards (OSB and plywood) was much higher in North America. This is most probably a reflection of the much higher proportion of housing construction in North America being timber frame. Reportedly less than 5 percent of housing construction in Europe is timber frame compared with around 90 percent in North America (CEI-Bois 2004).

That “structural” panels find application in the built environment of Europe is supported by the fact that 75 percent of OSB is used in the buildings industry, with a much smaller amount in packaging applications (Fig. 5).

As might be expected, the commodity “industrial” panels –particleboard and MDF – find use mainly in furniture and laminate flooring, but with substantial volumes of particleboard finding application in the building sector, especially as flooring material.

Engineered Wood and Other “New” Products in Europe

The primary EWC produced in Europe is glulam, the production of which in 2000 amounted to approximately 1.5 million m³, about 20 percent of this production is exported. This figure is slightly greater than the amount of glulam produced in North America which, again in 2000, amounted to some 0.9 million m³ (UNECE Timber Committee). Some examples of modern acceptance of glulam construction techniques are shown in **Figure 6**. European production of LVL, another major class of engineered wood product, amounted to some 125,000 m³ in 2002 (CEI-Bois); this figure is barely one-tenth of the amount produced in North America. The production of composite I-beams in Europe at around 8 million linear meters, is around one-thirtieth of that in North America.

Several other “new” wood-based products have been developed in recent years and are now beginning to appear on the market. Most notable of these are perhaps wood-plastic composites (WPCs) and heat-treated tim-

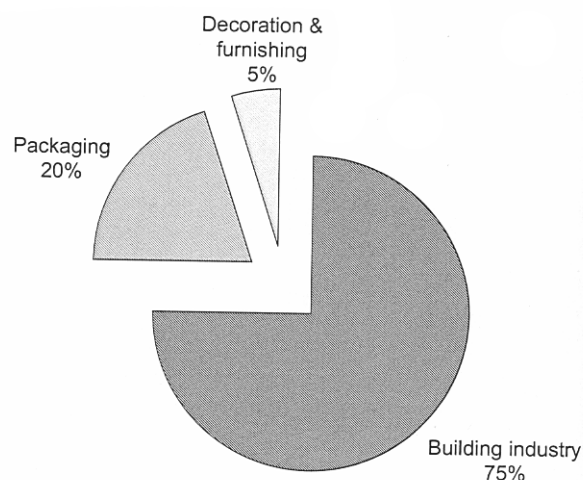


Figure 5. – European consumption of OSB. (Source: European Panel Federation.)

ber. WPCs have seen significant growth in North America in recent years, mainly in the construction sector as decking materials and the like. Although the production and consumption of these products in the EU is at present very limited, interest remains high and it is expected that their use will increase in time (Optimat and MERL 2003). Heat treating wood can improve its dimensional stability and resistance to biodegradation, as well as altering the appearance of lighter color species (Tekes). Because heat-treated wood is a chemical-free method for enhancing durability, it has become increasingly popular in Europe.

In terms of the consumption of wood-based products in Europe, a slightly different picture emerges from that in North America. Although there are regional variations, the key difference in consumption patterns is that, relatively speaking, significantly lower amounts of wood-based products are used in the built environment in Europe. This is reflected in the pattern of consumption of wood-based products; in the EU, significantly lower volumes of structural panels are consumed. In 2004, the EU consumption of structural panels (plywood and OSB)

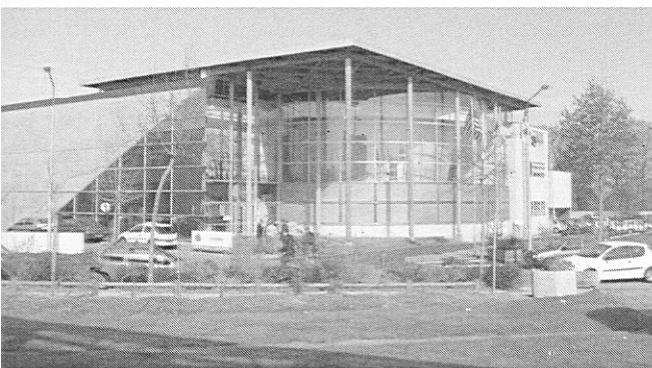
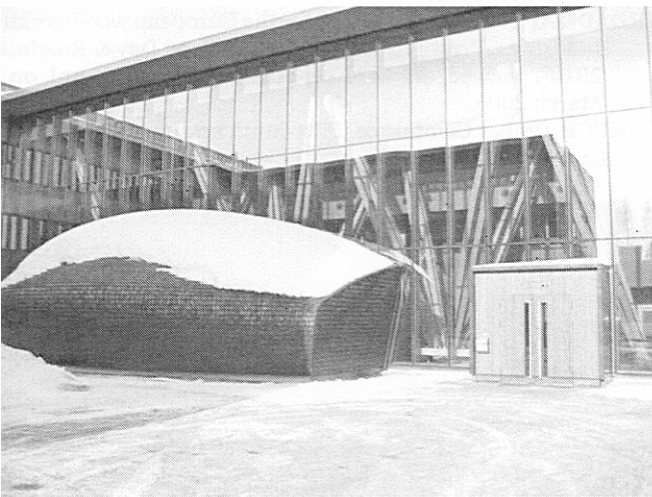


Figure 6. – *Examples of modern glulam construction in Finland (top and center) and France (bottom).*

amounted to some 9 million m³, while in North America the figure was around 46 million m³. With the exception of glulam, the consumption of EWP in North America is also substantially higher and indeed there is little consumption of other EWPs such as PSL and LSL in the EU at the present time. Overall, therefore, it can be concluded that in the EU at present the consumption of structural EWCs is limited, when compared with North America. What consumption there is mainly occurs in the building industry which, as we have seen, does not rely on timber to the same extent as it does in the United States and Canada. Clearly there is scope for expanding the market share for EWCs in construction and it is appropriate to consider some of the drivers and barriers to the wider adoption of these materials in Europe.

Drivers and Barriers

Timber and wood-based products can offer considerable environmental and social benefits when compared with materials such as steel and concrete. The Confederation of European Woodworking Industries, CEI-Bois, has started a process which aims to make “wood and wood-based products the leading material in both construction and interior solutions by 2010” (CEI-Bois press release “Wood Day & 2010 Roadmap”). A study entitled “Roadmap 2010 for the European Woodworking Industries” was conducted and published in 2004. Part of the study included an investigation into the barriers to the enhanced use of wood in Europe (Bregulla et al. 2003). The findings of this study highlighted that there were no particular regulatory barriers to the greater use of engineered wood products in Europe, although certification procedures, which could be both costly and lengthy, were seen as barriers. In addition to this, the perceived fire performance of engineered wood was seen as a barrier.

A range of other general barriers to the enhanced use of wood were also identified by the report. These included institutional, technical, economic, and perceptual barriers. Of the technical barriers identified, durability was viewed to be the most important. This is a particularly pertinent issue, since while durability might not be a major problem in itself, the perception of the lack of durability certainly is. This was brought into sharp focus in a television program shown in the United Kingdom in 1983 in which problems of rot in timber framed housing were exposed. Almost overnight the timber frame housing industry was decimated, and it has only been in the last few years that timber frame housing has begun to recover significantly. Nevertheless, even though it was shown 20 years ago, the program is still referenced. Whether the problems at the time were real or imagined, the effect of this “bad publicity” has been long lived.

Durability

The durability of EWPs and all wood-based products will depend upon the situation in which they are used. Broadly these can be categorized as interior and exterior situations. EN335 describes five hazard categories ranging from 1 “aboveground covered (dry)” to 5 “in salt water” with corresponding wetting descriptions ranging from “permanently dry” to “permanently wet.” Biological agents responsible for degradation are also described. In addition to biological attack, the durability of EWPs will also be affected by physical factors such as fluctuating conditions of humidity. Most EWPs (mainly OSB and LVL), with the exception of glulam, are currently used mainly in interior situations, as elements in timber-frame construction or in flooring. Glulam, while used extensively in large buildings, is also used in the construction of large structures such as bridges.

When it comes to building with wood, in the future, Eurocode 5 (EN1995) will guide the future design of timber structures. The Eurocodes are a set of unified international codes of practice that will, in time, replace national codes such as those produced by the BSI in the United Kingdom. Eurocode 5 has three parts covering (i) common rules and rules for buildings (EN1995-1-1), (ii) fire (EN1995-1-2), and (iii) bridges (EN1995-2). Eurocode 5 employs the limit state concept, rather the permissible stress method which the former BSI and some other EU timber codes have used. With regard to the biological durability of wood and wood-based products, Eurocode 5 states that timber and wood-based materials should be preservative treated in accordance with EN 351-1 and EN 460, if required.

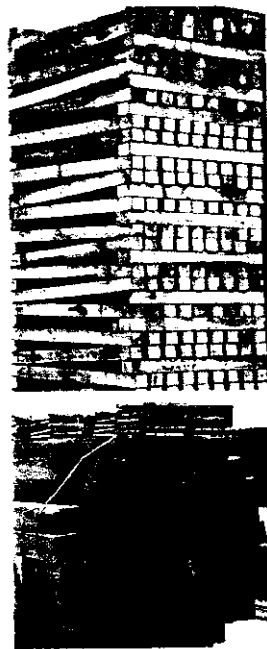
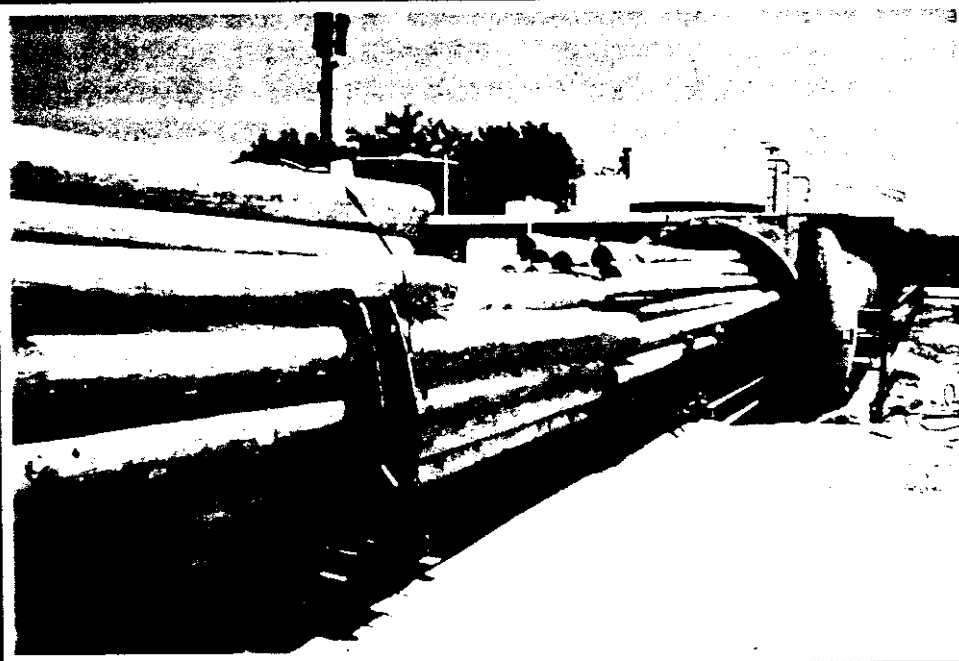
Conclusions

The use of engineered wood products, with the exception of glulam, is very limited in Europe at the present time and certainly significantly less than in North America. Structural panel products, such as plywood and OSB, are also used to a far lesser extent than they are in North America, reflecting the relatively lower amount of wood-based products used in building and construction. Nevertheless, it is seen that these products offer scope for increased use in applications within the built environment.

Literature Cited

- Bregulla, J., R. Grantham, H.E. Johansson, and V. and Enjily. 2004. BRE Client report number 714-393 Barriers to the enhanced use of wood in Europe: Particular attention to the regulatory barriers. Buildings Research Establishment Ltd., Bucknalls Lane, Garston, Watford, UK.
- CEI-Bois. 2004. Roadmap 2010 for the European Woodworking Industries. European Confederation of Woodworking Industries, Bruxelles.
- EN1995 Eurocode 5: Design of timber structures.
- Heat-treated wood – material of the future. Viewed at: www.tekes.fi/eng/news/uutis_tiedot.asp?id=1118&paluu=utisarkisto.asp 7th March 2006.
- Optimat Ltd and MERL Ltd. 2003. Wood Plastic Composites Study – Technologies and UK Market Opportunities. Production and Trade 2000-2004: UNECE/FAO limber Section. Viewed at: www.unece.org/trade/timber/mis/fp-stats.htm on 27 Feb. 2006.
- ROADMAP 2010 to lead the way for the European woodworking industries. Press release “European Wood Day & Roadmap 2010”, viewed at: www.cei-bois.org/frameset.html on 7 March 2006.
- UNECE Timber Committee, Fifty-ninth session, 2-5 Oct. 2001.

Wood Protection 2006



Wood Protection 2006

Edited by H. Michael Barnes

*Professor, Department of Forest Products,
Mississippi State University, Mississippi, USA*

*March 21–23, 2006
Omni Royal Orleans Hotel
New Orleans, Louisiana, USA*

*Sponsored by Arch Wood Protection, Inc.,
Chemical Specialties, Inc.,
Copper Care Wood Preservatives, Inc.,
Forest Products Society,
Osmose, Inc., and
limber Products Inspection, Inc.*



**Forest Products Society
2801 Marshall Ct.
Madison, WI 53705-2295
phone: 608-231-1361
fax: 608-231-2152
www.forestprod.org**

The opinions expressed are those of the authors and do not necessarily represent those of the Forest Products Society.

Copyright © 2007 by the Forest Products Society.

ISBN 1-892529-48-3

Publication No. 7229

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the written prior permission of the copyright owner. Individual readers and nonprofit libraries are permitted to make fair use of this material such as to copy an article for use in teaching or research. To reproduce single or multiple copies of figures, tables, excerpts, or entire articles requires permission from the Forest Products Society and may require permission from one of the original authors.
inted in the United States of America.

0703300