Dimensional stability performance of OSB circulating at the Greek market

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ABSTRACT

Oriented Strand Board is a Wood Based Panel which, although well known and widely used in many European countries is a rather new product for the Greek market resulting to its reduced application and -sometimes- improper use. Consequently, information about OSB properties is essential for its acceptance and proper use.

The aim of the present work was the determination of the effect that relative humidity changes have on the dimensional stability of OSB circulated at the Greek market. The sample material was composed of eight different commercial OSB panels imported from different mills. The procedure carried out comprised panel conditioning in three different controlled environments (20°C / 30%RH, 20°C / 65%RH, 20°C / 85%RH) and determination of changes in length and thickness according to EN 318/2002. The acquired values were compared to the requirements defined by EN 12872 and the panels were then classified to quality grades according to EN 300/1997 standard. The comparison showed that the tested panels partly conformed to the requirements defined for OSB/2, OSB/3 and OSB/4 grades. Comparison among the panels showed that, despite the relatively low variation of thickness and density, there were differences that could be justified by the use of qualitatively and quantitatively different raw materials and production technologies.

INTRODUCTION

OSB is a wood based panel with rapidly gaining popularity in the European market (Fig. 1). However, it is only imported but not manufactured in Greece. As structural panel OSB consists of 3 distinct layers of wood strands, with the strands of each of its layers aligned parallel to one another, but perpendicular to those in adjacent layers, like the cross-laminated veneers of plywood. The exploitation of small diameter round timber as raw material and the satisfactory properties of OSB have led to the partial replacement of plywood as well as sawn timber in many structural applications (Grigoriou and Ntalos 1997).

The main applications of OSB are wall and roof sheathing, I-beam web, flooring, pallets and transportation equipment (O'Halloran et al. 1996, Wu and Suchsland 1997). Increasingly manufacturers are using it in upholstered furniture production as it eliminates several process variables associated with the use of solid wood (Erdil *et al*. 2002). Hygroscopic materials such as wood require special attention since the variable conditions of exterior relative humidity and temperature can cause moisture content variations (Bryan 1962, Vital *et al*. 1980).

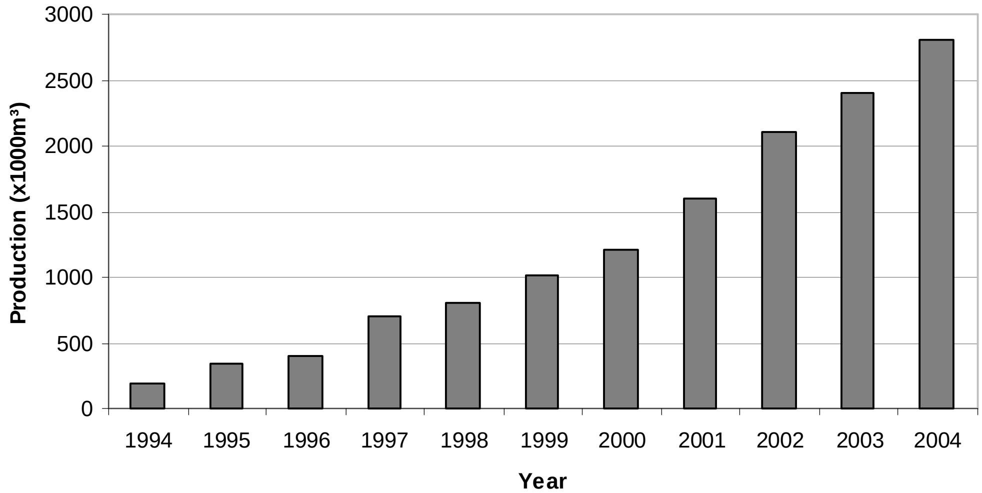

Figure 1. Production of OSB panels in Europe
(Source: European Panel Federation 2005, Lykidis and Grigoriou 2005)

The board's mechanical properties can substantially be deteriorated by increases of moisture content (MC). Furthermore, thickness swelling (TS) and linear expansion (LE) could have negative influence on product performance (Grigoriou and Ntalos 1997, Wu and Suchsland 1997, Wu and Piao 1999, FPL 1999, Grigoriou 2002). Additionally, it was proven by Xu and Suchland (1997) that linear expansion can provide information about the orientation level of strands thus greatly controlled by it.
The aim of the present work was the determination of the effect that relative humidity changes could have on the dimensional stability of OSB circulated at the Greek market. The determination was conducted according to the methodology defined by EN 318/2002. The results were compared to the guide values described in ENV 12872/2000 in order to classify the tested panels to the following OSB types defined by EN300/1997:

OSB/2 - Load-bearing boards for use in dry conditions.
OSB/3 - Load-bearing boards for use in humid conditions.
OSB/4 - Heavy-duty load bearing boards for use in humid conditions.

EXPERIMENTAL METHODS

The sample material was composed of eight different commercial OSB panels imported from various origins (six from European and two from North American mills) in the Greek market in order to be used as structural material. The selected panels were symbolized by the letters A, B, C, D, E, F, G and H. The panel dimensions were 2440x1220mm and their thickness varied from 10,5 to13,5mm. Eight specimens of 292x50mm were cut from each panel. Half of them had their length oriented perpendicular, while the other half parallel to the surface strands.
The specimens were separated in two sets (1 and 2). The two sets of specimens were conditioned to constant mass according to the following three steps (Table 1). The measurements of length, thickness and mass of the specimens were carried out after steps 2 and 3.

Table 1 : Conditioning climates for the two sets of test specimens (EN318/2002)

Step	Set 1	Set 2
1	20°C, 30%RH	20°C, 85 %RH
2	20°C, 65%RH	20°C, 65% RH
3	20°C, 85%RH	20°C, 30% RH

The conditioning of the specimens was conducted in three separate airtight chambers. Inside each chamber were created each of the three climates 20°C / 30%RH, 20°C / 65 %RH, 20°C / 85%RH using the appropriate saturated salt solutions: $MgCl_2 \cdot 6H_2O$, $NaNO_2$, and KCl respectively (Schneider 1960). Throughout the experiment, relative humidity and temperature values were recorded in each chamber using a thermo-hygrograph apparatus.

Figure 2. Length measuring equipment

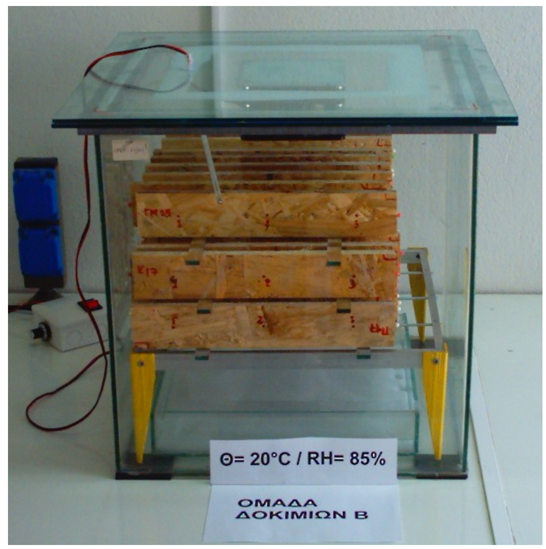

Figure 3. Conditioning chamber containing specimens

The only difference in the handling of the two specimen sets (1 and 2) was that they had reverse conditioning succession in the three chambers (s. Table 1) in order to determine the dimensional changes due to water adsorption and desorption.
At the end of each conditioning step (when constant specimen weight was reached) mass, length, and thickness measurements were conducted. At the end of the last conditioning step, all specimens were ovendried and weighed. Considering the measurements for all specimens, the changes of moisture content, length and thickness were determined for each panel and for each orientation (parallel and perpendicular to the panel length).

RESULTS AND DISCUSSION

The results for each panel are presented in Tables 2 and 3. Fig. 4 and 5 represent the relative changes in length and the changes in thickness (respectively) in relation to changes of moisture content after specimen's conditioning from normal (20°C / 65%RH) to humid (20°C / 85%RH) and from normal (20°C / 65%RH) to dry (20°C / 30%RH) environment, as defined by EN 318/2002. The changes of equilibrium moisture content in relation to change of relative humidity level from 30% to 85% and vice versa are shown in Fig. 6 and 7.
According to Tables 2 and 3, despite the small variation of panel densities, there is a relatively higher variation among the dimensional changes of some panels. Thickness changes after

conditioning in RH from 65 to 85% were higher than from 65 to 30%. Panels of higher density as expected had higher dimensional changes.

Concerning the comparison of the acquired values of linear expansion to the guide values defined by ENV 12872 it appears that all origins fulfill the defined values for the three OSB types. On the contrary, almost all panels showed linear shrinkage, thickness swelling and shrinkage values above the guide values set by ENV 12872 for the three OSB types.

Table 2. Dimensional changes of test panels after conditioning from 65 to 85%RH (20 °C) and comparison with the guide values, as described by ENV 12872/2000

Panel	Density [g/cm^3]	Moisture increase [%]	Linear expansion [%] – Length: Test[a] values	Length: ENV 12872 guide values OSB/2	OSB/3	OSB/4	Width: Test[a] values	Width: ENV 12872 guide values OSB/2	OSB/3	OSB/4	Thickness Swelling [%]: Test[a] values	ENV 12872 guide values OSB/2	OSB/3	OSB/4
A	0,68	4,29	0,09	0,13	0,09	0,09	0,10	0,17	0,13	0,13	3,28	3,00	2,15	2,15
B	0,71	4,76	0,10	0,14	0,10	0,10	0,12	0,19	0,14	0,14	7,58	3,33	2,38	2,38
C	0,61	4,03	0,04	0,12	0,08	0,08	0,05	0,16	0,12	0,12	3,43	2,82	2,02	2,02
D	0,60	4,23	0,08	0,13	0,08	0,08	0,07	0,17	0,13	0,13	4,90	2,96	2,12	2,12
E	0,60	4,00	0,05	0,12	0,08	0,08	0,07	0,16	0,12	0,12	4,00	2,80	2,00	2,00
F	0,61	4,31	0,07	0,13	0,09	0,09	0,07	0,17	0,13	0,13	3,95	3,02	2,16	2,16
G	0,62	3,96	0,08	0,12	0,08	0,08	0,10	0,16	0,12	0,12	2,48	2,77	1,98	1,98
H	0,60	3,81	0,05	0,11	0,08	0,08	0,07	0,15	0,11	0,11	3,43	2,67	1,91	1,91

[a]: mean values of eight specimens

Table 3. Dimensional changes of test panels after conditioning from 65 to 30%RH (20 °C) and comparison with the guide values, as described by ENV 12872/2000

Panel	Density [g/cm^3]	Moisture reduction [%]	Linear shrinkage [%] – Length: Test[a] values	Length: ENV 12872 guide values OSB/2	OSB/3	OSB/4	Width: Test[a] values	Width: ENV 12872 guide values OSB/2	OSB/3	OSB/4	Thickness shrinkage [%]: Test[a] values	ENV 12872 guide values OSB/2	OSB/3	OSB/4
A	0,68	3,94	0,16	0,12	0,08	0,08	0,17	0,16	0,12	0,12	2,18	2,76	1,97	1,97
B	0,71	4,23	0,14	0,13	0,08	0,08	0,13	0,17	0,13	0,13	3,33	2,96	2,12	2,12
C	0,61	4,02	0,08	0,12	0,08	0,08	0,10	0,16	0,12	0,12	2,58	2,81	2,01	2,01
D	0,60	4,40	0,12	0,13	0,09	0,09	0,12	0,18	0,13	0,13	3,20	3,08	2,20	2,20
E	0,60	4,03	0,10	0,12	0,08	0,08	0,11	0,16	0,12	0,12	2,68	2,82	2,02	2,02
F	0,61	3,74	0,09	0,11	0,07	0,07	0,12	0,15	0,11	0,11	2,55	2,62	1,87	1,87
G	0,62	3,79	0,13	0,11	0,08	0,08	0,15	0,15	0,11	0,11	2,23	2,65	1,90	1,90
H	0,60	4,19	0,08	0,13	0,08	0,08	0,10	0,17	0,13	0,13	2,90	2,93	2,10	2,10

[a]: mean values of eight specimens

There are many factors which can influence the dimensional stability of the panels. The variation of equivalent moisture content and dimensional changes can be caused by factors such as wood strand species, geometry and orientation of strands, adhesive type and content, additives (paraffin, inorganic components) as well as other manufacturing variables (Vital *et al*. 1980, Wu and Suchsland 1996, Wang and Winistorfer 2000, Xu 2000, Brochmann *et al.* 2004, Wang *et al.* 2004a, Wang *et al.* 2004b). Further studies investigating the correlation of dimensional stability to strand alignment as well as to the above mentioned factors should be carried out in order to make possible the prediction of dimensional changes without carrying out time-consuming tests.

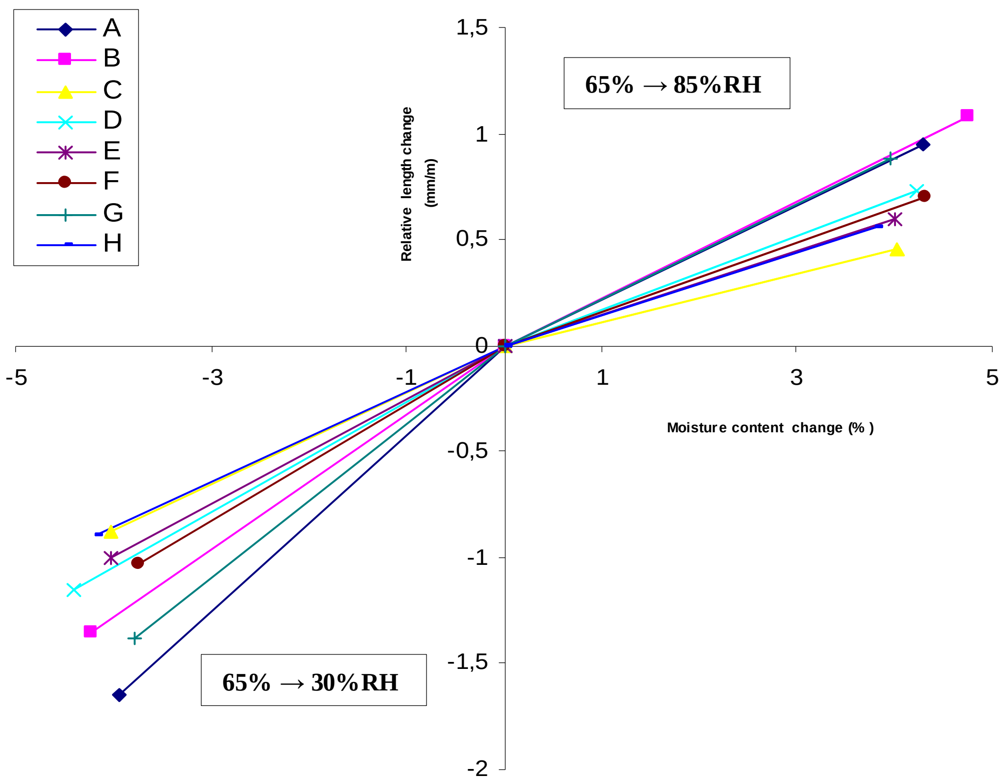

Figure 4. Relative changes in length in relation to changes of moisture content after conditioning from 65 to 85%RH and from 65 to 30%RH (according to EN 318/2002)

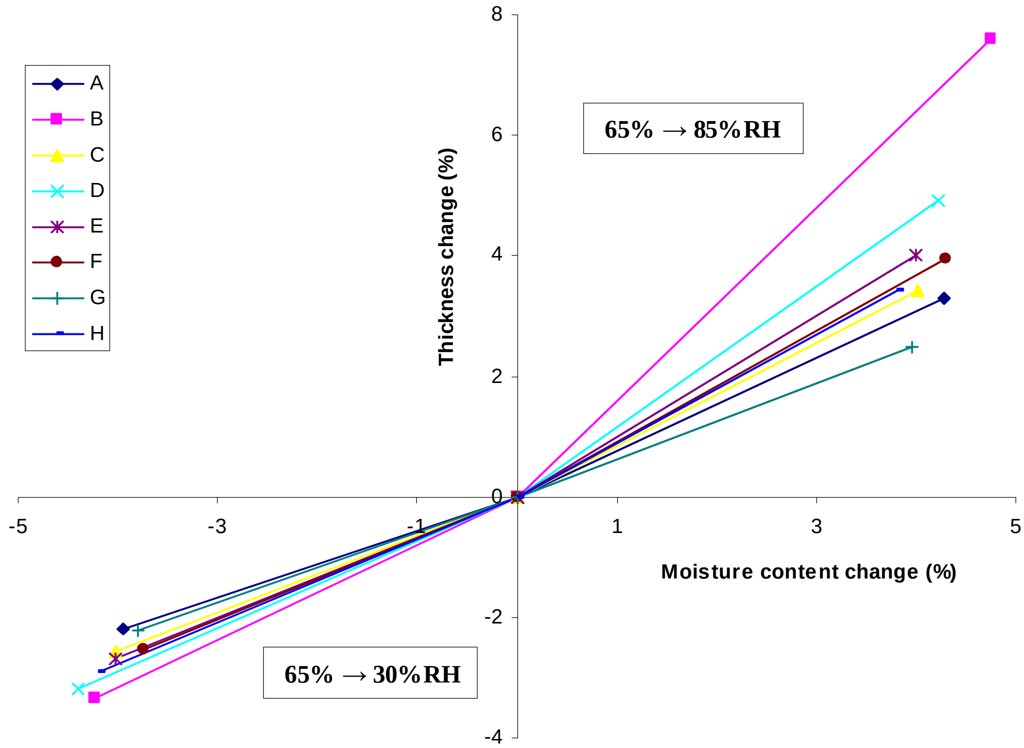

Figure 5. Changes of thickness in relation to changes of moisture content after conditioning from 65 to 85 %RH and from 65 to 30%RH (according to EN 318/2002)

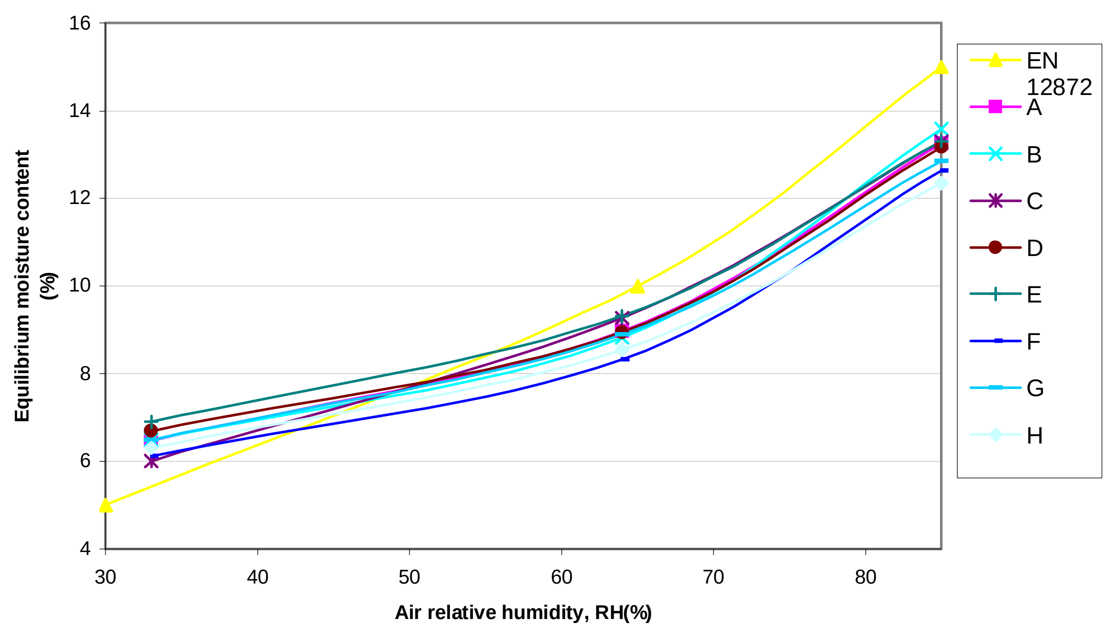

Figure 6. Panel equilibrium moisture content change in relation to changes in RH from 30 to 85% (ENV 12872 curve is put for comparison)

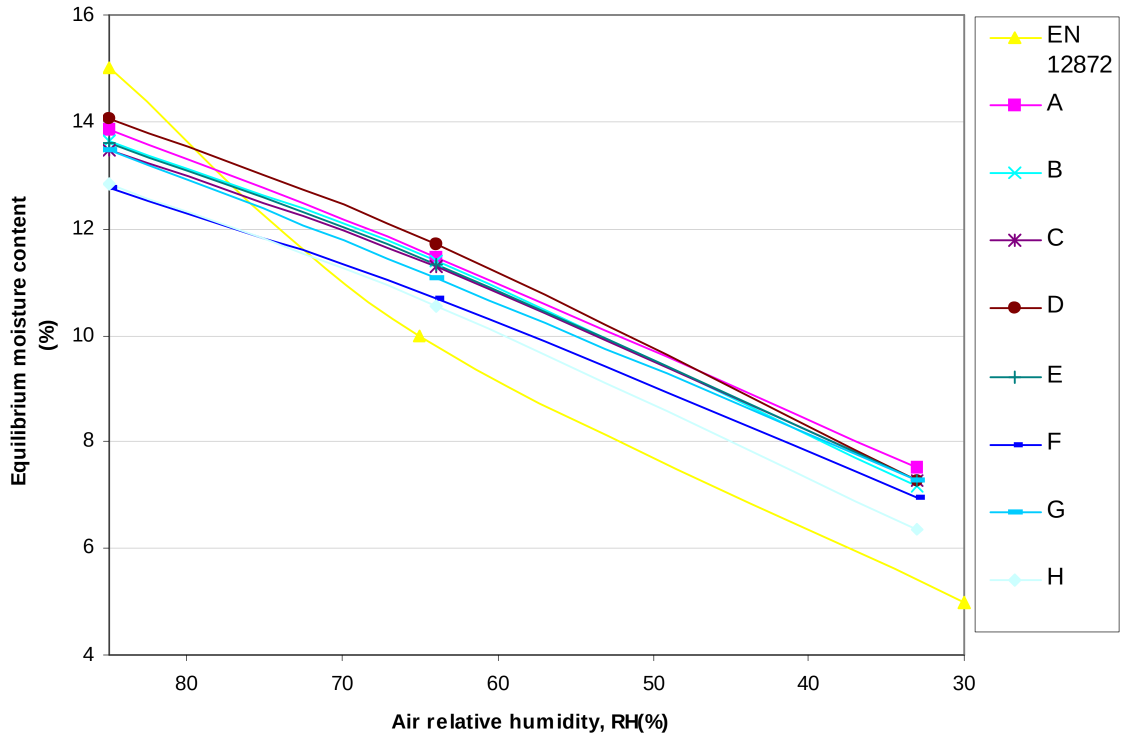

Figure 7. Panel equilibrium moisture content change in relation to changes in RH from 85 to 30% (ENV 12872 curve is put for comparison)

CONCLUSIONS

Oriented Strand Board is a Wood Based Panel which, although well known and widely used in many European countries, is a rather new product for the Greek market resulting to its reduced application and -sometimes- improper use. Consequently, information about OSB properties is essential for its acceptance and proper use.

The dimensional changes of OSB panels, imported in Greece from eight different mills, associated with changes in relative humidity were determined. The test values were compared to the guide values set by ENV 12872. It was found that the tested panels partly conformed to the requirements defined by ENV 12872 for OSB/2, OSB/3 and OSB/4 grades. The results also indicate that an important differentiation in dimensional stability between the eight panels exists which can be attributed to the use of qualitatively and quantitatively different raw materials, as well as to the different manufacturing variables.

Manufacturers using OSB panels as construction materials should be well informed about dimensional instability that may occur in association with climate changes as well as the available OSB grades in the domestic market so that they can choose the most appropriate one and avoid construction problems.

Further study aiming to find out correlation of dimensional stability with raw materials, processing parameters as well as with other properties of OSB should be carried out.

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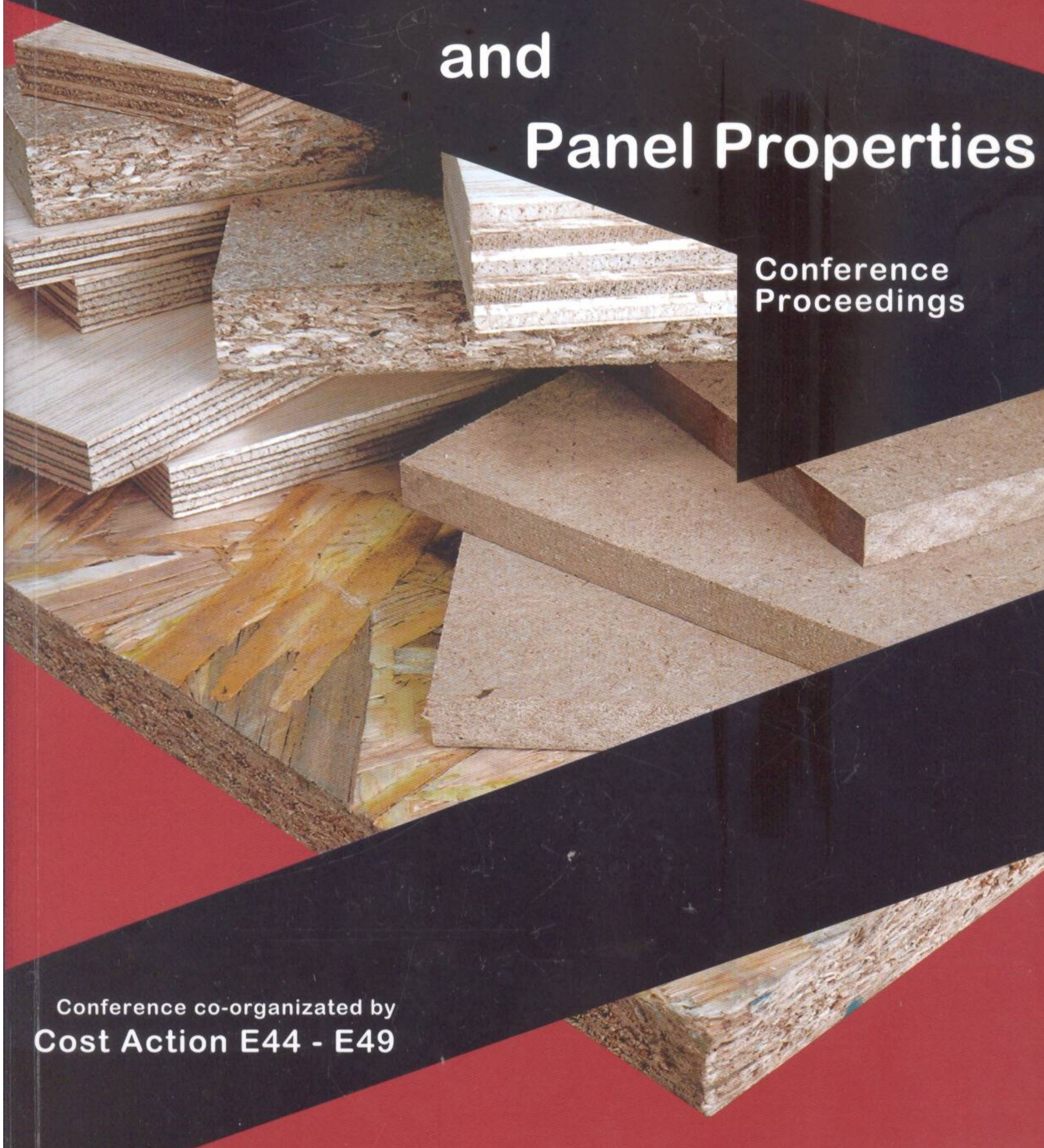

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