Internal Bond Strength of Laminated Flooring as Function of Water Exposure

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Abstract

Laminated flooring is widely used in many European countries over 20 years and getting more popular in North America having an important market share of flooring industry.
A wear resistance decorative paper usually saturated with melamine base resin is used in the core of overlay paper for laminated flooring manufacturing. Durability of laminated panels against moisture exposure is one of the most important properties of such panels. In this study commercially manufactured high density fiberboard (HDF) based laminated samples were exposed to a sequence of 2 hrs, 24 hrs and 15 days water soaking test. Internal bond (IB) strength from 2 in by 2 in by 0.25 in samples was determined at each exposure level. All of the failures took place in the core layer of the specimens. Based on initial results of this work IB strength of the samples reduced from an average value of 340 psi to 300 psi as a result of 2-hr water exposure. When the samples were kept in water for 24 hrs and 15 days their IB strength reduction was not substantial. It appears that 24 hrs water soaking exhibited the maximum damage on IB strength characteristics of the samples. No statistical significant difference between IB values of the samples exposed to water soaking for 24 hrs and 15 days was determined at 95% confidence level. This may suggest that IB strength values of the samples were not influenced with an extension of water exposure time beyond 24 hrs. Samples also did not exhibit any delamination following the soaking test. In further studies other properties including bending strength and hardness of the samples would be evaluated to have a better information about influence of water exposure on properties of laminated flooring panels.

Keywords: Internal bond strength, laminated flooring, HDF, water exposure.

Introduction

Laminated flooring was introduced to the US in 1982 and the industry has been growing up to 20% per year since then (Beauregard 1998). Solid flooring is one of the most desirable architectural applications widely used in many constructions. However its cost and limited resource created an important market for flooring made from laminated composite panels. The main advantage of laminated flooring is its lower cost and easier installation as compared to that of solidwood. A typical laminated flooring consists of four main elements which are bonded together in the form of sandwich. High density fiberboard (HDF) having a density above 0.85-0.86 g/cm^3 is the most commonly used composite panel as core layer for laminated flooring (Kalaycioglu et al. 2006, Blachet et al. 2003). Decorative melamine base resin saturated papers and abrasion resistance top layer are laminated to the base HDF panel under pressure and heat. A thin sheet made of aluminum oxide saturated film and a balancing backing are also put on the top of decorative paper and on the back of the panel, respectively. The main purpose of aluminum oxide film is to protect the surface against any stain. Durability of laminated flooring is one of the most important properties influencing its service life. Some of the flooring panels may have twenty times higher strength and durability than that of typical laminated kitchen countertop. Any kind of deterioration and reduction in strength properties of flooring as a result of high humidity exposure or contact with excessive moisture content would effect its efficient use (Bishop 1990, Bodig et al. 1993). Therefore it is important to evaluate internal bond (IB) strength of such products as function of water exposure so that behavior of the samples can be better understood. The main objective of this experimental study is to have an initial data about IB strength of commercially produced flooring exposed to water soaking for various time spans. This data can be used as a quality control tool to improve hygroscopic behavior of laminated flooring so that they can be utilized more efficiently during their service life.

Material Methods

Commercially manufactured HDF and laminated samples were used for the experiment. A set of both types of panels were also considered as control samples. A total of 160 samples, 40 for each run were used to determine IB strength of the samples. Specimens were randomly cut in 2 in by 2 in 0.25 in from 6 in by 6 in samples for IB test. Later laminated and HDF samples were soaked in distilled water for 2 hrs, 24 hrs, and 15 days prior IB test. After each soaking period samples were rinsed and weighed at an accuracy of 0.01 g. They were dried overnight in a room temperature before they were glued on aluminum blocks using hot melt adhesive for IB tests. Comten testing unit equipped with 1,000 lb load cell was used for evaluation of IB strength of the samples. Cross head speed for the test was 0.02 in/ min.

Figure 1. Typical core failed IB sample.

Results and Discussion

Results of IB strength of the samples are presented in Table 1 and Figure 2. An average IB value for dry samples was 340 psi which is 16.6 % higher than those of exposed to

Panel Type	Internal Bond Strength (IB) - psi
Control samples	340
2-hrs soaked	300
24-hrs soaked	260
15 days soaked	250

Table 1. Average values IB values of the samples.

2-hrs soaking. Reduction in IB strength value of the sample increased with increasing water soaking time. Samples kept in water for 15 days had the lowest IB value of 250 psi which is 20 % and 40 % lower than those of 24 hrs and 2 hrs soaked samples, respectively. No statistically significant difference was found between IB strength values of 24 hrs and 15 days soaked samples suggesting that water soaking time did not influence IB characteristics of the samples beyond 24 hrs soaking. However first several hours water exposure significantly reduced overall IB values of the samples. This could be related to springback and stress release of the sample which reach to saturation with reducing rate as they are exposed to water for longer period of time. All of the samples failed in the core as illustrated in Figure 1. None of the samples exhibited any delamination of the overlay or any separation within the sample itself. Based on the findings of this study it seems that such commercially manufactured samples had satisfactorily IB strength properties as a result of water exposure. In further studies some of the other mechanical properties such as bending and shear strength of the samples exposed to water would be desirable to evaluate to have better understanding of the samples as function of possible water exposure during their service life.

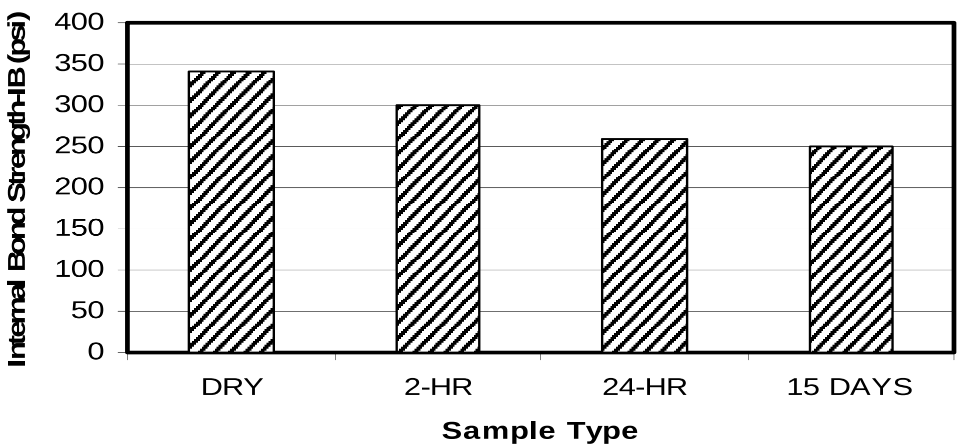

Figure 2. Internal Bond Strength Test Results.

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