IMPACT OF LOADING RATE ON MOR AND MOE OF THE PARTICLEBOARD APPLYING A STANDARD BENDING TEST

Mira Mirić-Milosavljević, Vladislava Mihailović, Marija Đurković

ABSTRACT

According to the European Standard EN 310:1993 for determination of the MOE and MOR of wood-based panels, it is necessary to select the loading rate on test samples, so that the maximum load is reached within 60 ± 30s (30-90s). During the test the sample often breaks after only a few seconds, which is far below the required lower time limit. The results obtained for these samples should be discarded; otherwise the resulting values for MOR and MOE will be biased.
This paper is focused on the impact of loading rate on MOR and MOE of the particleboard in a standard bending test. The test was carried out in two ways: (i) by using the maximum load that can be obtained on the test device, and (ii) by applying a much lower load, for which the sample failure occurs at the prescribed time interval. In either case, the given time for achieving the maximum load was the same, which resulted in significant differences in loading rates. The obtained results for MOR and MOE were compared. Differences in the values obtained in the two applied loading rates indicate a potential error that can be made in determining MOR and MOE if the requirement regarding the time prescribed to reach the maximum force is not met.

REFERENCES

Ambartsumyan, S.A. (1970): Determination of the state of stress and deformation of plates. In: Theory of anisotropic plates, Lancaster, U.S.A.:Techonomic Pub. Co.

Ashkenazi, E.K. (1978): Anizotropia drewesiny and drewesnykh materialow, Moskva: Lesnaya Promyshlennost.

Barbuta, C., Blanchet, P., Cloutier, A. (2012): Mechanical Properties of Unidirectional Strand Board (USB) with Flat Vertical Density Profile, Journal of materials science research, 1 (3): 42-49, http://dx.doi.org/10.5539/jmsr.v1n3p42.

Chen S., Du, C., Wellwood, R. (2010): Effects of Panel Density on Major Properties of Oriented Strandboard, Wood and Fiber Science, 42 (2): 177-184.

EN 310 (1994): Wood-based panels. Determination of modulus of elasticity in bending and of bending strength.

EN 312 (2003): Particleboard. Specifications.

EN 322 (1993): Wood - based panels. Determination of moisture content.

EN 323 (1993): Wood-based panels — Determination of density.

Forest Products Laboratory, (1999): Wood handbook—Wood as an engineering material, USDA, Forest Service, General Technical Report FPL–GTR–113, Madison, Wiskonsin.

Forest Products Laboratory, (2010): Wood handbook—Wood as an engineering material, USDA, Forest Service, General Technical Report FPL-GTR-190. Madison, Wiskonsin.

Gerhards, C., C. (1977): Effect Of Duration And Rate Of Loadingon Strength Of Wood And Wood-Based Materials, , USDA, Forest service, research paper FPL 287, Forest product laboratory Madison, Wiskonsin.

Hrázský, J., Král, P. (2009): Determination of relationships between density, amount of glue and mechanical properties of OSB. Drvna industrija, 60 (1): 7-14.

Jacques, E., Lloyd, A., Braimah, A., Saatcioglu, M., Doudak, M., Abdelalim, O. (2014): Influence of high strain-rates on the dynamic flexural material properties of spruce–pine–fir wood studs, Can. J. Civ. Eng. 41: 56–64, http://dx.doi.org/10.1139/cjce-2013-0141.

Jin, J., Dai, C. (2010): Characterizing Variability of Commercial Oriented Strandboard: Bending Properties. Forest product journal, 60 (4): 373 – 381.

Kelly, M.W. (1977): Critical Literature Review of Relationships Between Processing Parameters and Physical Properties of Particleboard. General Technical Report, FPL-10, U.S. Department Of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin, SAD.

Kollmann, F., Cote, W. (1984): Principles of wood science and technology, Vol. 1, Springer-Verlag.

Kulman, S., Boiko, L., Pinchevska, O., Sedliačik, J. (2017): Durability Of Wood-Based Panels Predicted Using Bending Strength Results From Accelerated Treatments , Acta facultatis xylologiae zvolen, 59(2): 41−52, Technická univerzita vo Zvolene, DOI:10.17423/afx.2017.59.2.04.

Lekhnitskii, S.G. (1984): Theory of bending of anisotropic plates. In: Anisotropic plates, New York: Gordon and Breach science publishers.

Maraghi, M., M., R., Tabei, A., Madanipoor, M. (2018): Effect Of Board Density, Resin Percentage And Pressing Temprature On Particleboard Properties Made From Mixing Of Poplar Wood Slab, Citrus Branches And Twigs Of Beech, Wood Research, 63 (4): 669-682.

McNatt, J., D. (1975): Effect of rate of loading and duration of load on properties of particleboards, USDA, Forest service, research paper FPL 270, Forest product laboratory Madison, Wiskonsin

Rowell, R., M. (2005): Handbook of wood chemistry and wood composites, CRC Press, ISBN 0-8493-1588-3.

Souza, A., Varanda, L., Christoforos, A., Nascimento, M., Poleto, S., Panzeras, T., Lahr, F. (2014): Modulus of Elasticity in Static Bending for Oriented Strand Board (OSB).International journal of composite materials, 4(2): 56-62, http://dx.doi.org/10.5923/j.cmaterials.20140402.

Sumardi, I., Kojima, Y., Suzuki, S. (2008): Effects of Strand Length and Layer Structure on Some Properties of Strandboard made From Bamboo, Journal of Wood Science, 54 (2): 128 - 133.

Suzuki, S., Takeda, K. (2000): Production and properties of Japanese oriented strand board I: effect of strand length and orientation on strength properties of sugi oriented strand board, Journal of Wood Science, 46(4): 289 - 295.

Thomas, W.H. (2001): Mechanical properties of structural-grade oriented strand board. Holz als roh- und werkstoff, 59: 405-410.

Thomas, W.H. (2002): Shear and flexural deflection equations for OSB floor decking with point load. Holz als roh- und werkstoff, 60: 175-180,

http://dx.doi.org/10.1007/s00107-001-0279-4.

Thomas, W.H. (2003): Failure models and trend curves for load capacity and stiffness of OSB panels subjected to concentrated load. Materials and structures, 36: 68-72.

Timoshenko,S., Woinowsky-Krieger, S. (1959): Theory of plates and shells, New York: McGraw Hill book company.

Tsen, S.F., Jumaat M. Z. (2012): Comparison of Eurocodes EN310 and EN789 in Determining the Bending Strength and Modulus of Elasticity of Red Seraya Plywood Panel, International Journal of Civil and Environmental Engineering, 6 (2): 159-163.

Warmbier, K., Wilczyński, M., Danecki, L. (2014): Effects of some manufacturing parameters on mechanical properties of particleboards with the core layer made from willow Salix viminalis, Annals of Warsaw University of Life Sciences - SGGW Forestry and Wood Technology, 88: 277-281.

Xu, W. (1999): Influence of Vertical Density Distribution on Bending Modulus of Elasticity of Wood Composite Panels: A Theoretical Consideration, Wood and Fiber Science, 31 (3): 277-282.

Yapici, F., Esen, R., Yorur, H. (2013): The Effects Of Press Time And Press Pressure On The Modulus Of Rupture And Modulus Of Elasticity Properties Of Oriented Strand Board (Osb) Manufactured From Scots Pine, Pro Ligno, 9 (4): 532-535, ISSN-L 1841-4737.

Zhou, J., Hu, C., Hu, S., Yin, H., Jiang, G., Zhang, S. (2012)., Effects of temperature on the bending performance of wood- based panels, Bioresources, 7 (3): 3597-3606.