Bending and compression strength of Portuguese Maritime pine small-diameter poles

T.F.M. Morgado J. Rodrigues J.S. Machado
A.M.P.G. Dias H. Cruz

Abstract

Portuguese pine forests frequently have high density due to the large number of young trees, which are maintained in the stands due to the high costs of thinning operations and the lack of financial return provided by the markets available for small-diameter poles. With this problem in mind, a national project was launched to investigate the use of Maritime pine small-diameter poles in structural applications. It is believed that this utilization could promote stand thinning operations by providing extra income to forest owners. Poles for the study were collected in an interior central region of Portugal and visually graded according to European standard EN1310. Poles were then tested (bending and compression) following European standard EN14251.The results obtained are presented and discussed along with the results obtained for round timber from other wood species and for Maritime pine strength graded structural timber with rectangular cross section. Considering future development of national strength grading standards (based on the results of this project), some correlations are presented between wood features and mechanical properties and between bending strength and stiffness. Good correlations were obtained between bending strength, density, and local modulus of elasticity (MOE). A significant difference in the bending strength between round and rectangular cross sections was observed but not for MOE.

Portuguese forests have problems of high density due to lack of organization. Similar problems have been reported in United States, such as in the forestland of the Inland Northwest (Erikson et al. 2000), Appalachia, southern pine plantations in the south (Patterson et al. 2002), and in the forestland along the Colorado Front Range (Mackes et al. 2005). This situation results in a higher risk of wild fires, such as the catastrophic fires in 2003 in Portugal. It also promotes the spread of diseases.

Usually stands of Portuguese forest Maritime pine (*Pinus pinaster* Ait.) are the result of natural regeneration. Increasingly they are a consequence of forest fires or established plantation with no after-care operations (cleaning, thinning, etc.). Therefore, pine stands generally have a large number of young trees that if removed in due time could increase the quality of mature trees and decrease the risk of fire. The large number of young trees in the stands, which should have been removed by regular thinning operations, is generally due to the high cost of this operation and the lack of profitable end-uses for the small-diameter poles (Wagner et al. 1998, Fight et al. 2004).

Although applications for wood material removed from the stands by after-care operations exist (pulp, biomass, or poles for fences), these are applications with small added value. To help offset thinning costs, higher value products using small-diameter material should be identified and developed, such as structural applications. Nevertheless, the use of small-diameter poles in structural applications is only possible if poles are selected (graded) and the mechanical properties for each grade are known.

Several studies have been done with that purpose. de Vries (1998a, 1998b) determined modulus of elasticity (MOE) and bending strength of roundwood larch (*Larix kaempferi*) from the Netherlands. For the same specie, de Vries and Gard

The authors are, respectively, Research Assistant and Research Assistant, Faculdade de Ciencias e Tecnologia da Universidade de Coimbra (DEC da FCTUC, Faculty of Sciences and Technology, Univ. of Coimbra), Coimbra, Portugal (telmo.morgado@gmail.com, joao.nar@hotmail.com); Research Officer, Laboratório Nacional de Engenharia Civil (LNEC, National Lab. for Civil Engineering), Lisboa, Portugal (saporiti@lnec.pt); Assistant Professor, DEC da FCTUC, Coimbra, Portugal (alfgdias@dec.uc.pt); and Senior Research Officer, LNEC, Lisboa, Portugal (helenacruz@lnec.pt). This paper was received for publication in June 2008. Article No. 10501.

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