EVALUATION OF INTERFERENCE GENOTYPES – ENERGY RELEASE RATE BY USING WEDGE SPLITTING TEST

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Abstract: The purpose of the present study was to observe the interference genotypes – energy release rate. The tests were performed using the wedge splitting samples manufactured from the Douglas genotypes. Four Douglas genotypes were selected in order to observe the influence of genetic background on the mechanical behavior. In order to evaluate the fracture parameters the experimental measurements were realized by using the optical methods such as mark tracking method and digital image correlation. Using the optical measurements the fracture parameters were calculated by using the energetic approaches coupled with the numerical simulations. The moisture content influence was also studied. Then, the experimental tests were performed for different moisture contents.

1. Introduction

Cracking is one of the recurring pathological consequences in timber elements. The crack presence reduces the durability of the structure or even affects its behavior, by facilitating the migration of aggressive agents within the material. The environmental conditions in terms of temperature and relative humidity, the moisture content and/or the heterogeneity of the wood material are some parameters which can affect the timber elements durability. Today, several preservative technologies allow to improve the timber elements, durability [1]. However, these solutions allowing to ensure a long life of timber have a significant environmental impact [2]. Today, the genetic selection or the genetic improvement can be considered as the alternative solutions allowing to ensure the natural durability of wood material. Starting from this hypothesis the purpose of the present study is to observe the mechanical behavior of four Douglas genotypes. Using the energy release rate as a marker the mechanical behavior of the four genotypes of Douglas was investigated. The idea is to observe if the genetic background can influence significantly the mechanical durability.

2. Results

The experimental setup including the electromechanical press, the sample and the measurement devices is illustrated in Figure 1a.

In the present study the fracture behavior was investigated using the wedge splitting samples. From the experimental measurements by optical methods the fracture parameters such as energy release rate, crack relative displacement factor and stress intensity factor were calculated. Using the optical techniques the fracture parameters were calculated by coupling the local-global approaches. Then, the energy release rate was calculated from the energetic approaches by using the integral invariants. As illustrated in Figure 1 the displacement fields are measured by using mark tracking method [3] and digital image correlation [4]. Then, the

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sample surface is covered with a white and black speckle pattern for the measurements by digital image correlation. For the mark tracking method the black or white marks are applied on the sample surface.
The preliminary results obtained for a moisture content of 10% are resumed in Figure 1b.

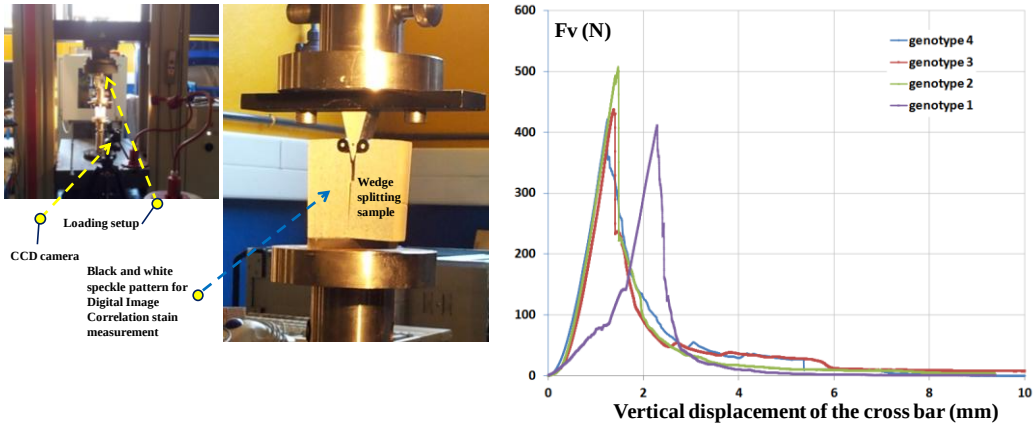

Figure 1. a) Experimental setup; b) Load-displacement relationship

These results show a variation of the mechanical behavior in term of sample stiffness and loading capacity.
From experimental data optimized by an adjustment procedure, the kinematic state in the crack tip vicinity is evaluated through the crack relative displacement factors. In parallel the stress state in vicinity of the crack tip is evaluated by a numerical analysis. This analysis is performed by using the finite elements method and the integral invariant, in order to evaluate the stress intensity factor. The finite element analysis is based on the reproduction of experimental test in terms of specimen geometry, experimental boundaries conditions and loading configurations. Then the energy release rate can be estimated by coupling of these two factors calculated without considering the material elastic parameters. Moreover, this method allows defining the local mechanical behavior.

3. Conclusions

The present study allows to observe the effect of Douglas genotypes variability on the fracture parameters. Using a coupling between the optical measurements and numerical approach the fracture parameters in opening mode were investigated. Based on the experimental optical measurements, the energy release rate was performed by means two methods, Crack Relative Displacement Factor and J-integral, respectively. The present study allows also concluding that the Crack Relative Displacement factor coupled with Stress Intensity Factor approach provides a good estimation of energy release rate without the knowledge of material elastic properties. This approach allows considering the assessment of fracture parameters for the real structures.

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