Enhanced durability of structural bonded timber joints. Effectiveness of adhesion promotion techniques.

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ABSTRACT

Long-term durability of a structural adhesive joint is an important requirement, because it has to be able to support the required design loads, under service conditions, for the planned lifetime of the structure. Epoxy adhesives, whilst not ideal, are currently the best family of adhesives for *in situ* repair operations. As long as the bonded joint remains dry and unexposed to high service temperatures, epoxy adhesives produce strong bonds to timber. However, once they are exposed to severe stresses as a result of repeated water soaking and drying cycles, the bonded joint delaminates and does not fulfil the requirements for structural timber adhesives intended for exterior exposure. One way of improving bond durability is through the use of surface treatments prior to bonding. In this study, the effects of four surface treatments on three timbers (maritime pine, iroko and European oak) were evaluated through contact angle measurements (Dynamic Contact Angle Analysis using the Wilhelmy plate method) and compressive lap/shear tests involving weathered and non-weathered epoxy-bonded specimens. The results proved that surface modification methods for adhesion promotion can be adapted to cellulosic substrates with significant improvements in bonded joint durability.

1. Introduction

Adhesive bonding technology has played an essential role in the development and growth of the rehabilitation and repair of timber structures in recent years. The advantages of this method in comparison to traditional repair techniques are many, but one major remaining concern is the durability of both the adhesive and resultant adhesion to the timber. Although high initial bond strengths are relatively easy to achieve, obtaining good bond durability is comparatively more difficult. The ability of a joint to maintain satisfactory long-term performance, often in severe environments, is therefore an important requirement of a structural adhesive joint (Custódio *et al.*, 2009).

Additional bonding schemes (*e.g.*, primary and/or physical bonds that are less susceptible to degradation) can be used to improve durability. These include the use of primers, adhesion promoters and other surface treatments. Despite the extra cost associated with them, their use is of particular value where structural bonds may be subjected to repeated wetting and drying (Custódio *et al.*, 2008b). These agents are quite common in the aerospace, automotive and plastics industries, where they are used to develop highly durable bonds to metals, advanced