Supplementary files

Innovative research of wood modification treatment to improve the water resistance of wood for rotary welding, this process method can be used for wood products and furniture products.

This file includes:

1. Experimental programme

Table.S1 Test scheme design.

Test group	Treatment area	Type of treatment	bonding method	Number of test pieces/pc
Group A	Substrate hole Dowel surface	Spray finishing fluids Impregnating treatment solution	Rotary Friction Welding	70
Group B	Substrate hole Dowel surface	No treatment Impregnating treatment solution	Rotary Friction Welding	70
Group C	Substrate hole Dowel surface	No treatment No treatment	Rotary Friction Welding	70
Group D	Substrate hole Dowel surface	No treatment No treatment	PVAc glue joint	70

2. Experimental procedure

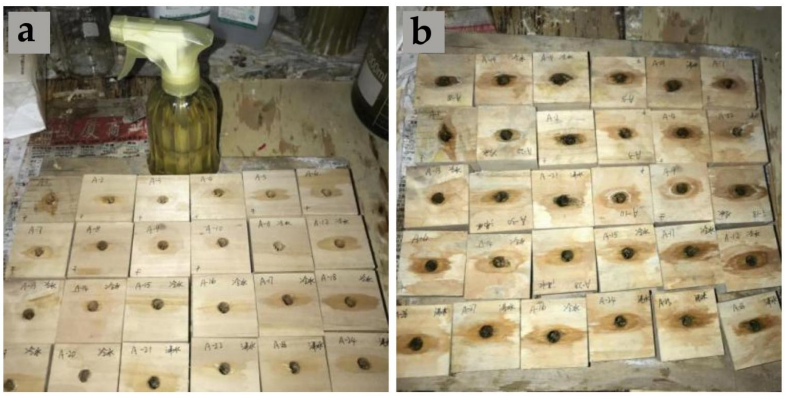

Figure S1. Pretreatment methods and the process of the poplar hole, (a) Substrate hole sprayed with oxidising agent; (b) Substrate hole sprayed with a sulphonating agent.

Figure S2. Pretreatment methods and the process of the wood dowel, (a) Dowels impregnated with an oxidising agent; (b) impregnation of dowels with sulphonating agents; (c) Spraying with an ethanolic solution of zinc acetate.

3. Mechanical tests

As shown in Figure 4, the model UTM5105 (Shenzhen Sanshi Zongheng) with a maximum test force of 10KN, a test environment temperature of 20-25°C and a relative humidity of 45-65% was used to test the bonding strength of all welded and glued specimens, as shown in Figure 4. The test method refers to the national standard GB/T 14018-2009 "Wood Grip Test Method", i.e. the gluing strength test is carried out by means of tensile strength. The test is carried out with the lower round tenon fixed, and the wooden substrate is pulled upwards at a loading speed of 2 mm/min until the substrate is completely free from the tenon, when the maximum pull-out force is measured. The tensile strength of the glued specimen is then calculated according to the following formula (1):

$$\sigma_k = \frac{F_{max}}{S} = \frac{F_{max}}{2\pi rh} \quad (1)$$

Where, σ_k is the bond strength, i.e. tensile strength, in MPa; F_{max} is the tensile pull-out force, in N; S is the adhesive tape surface, in mm; r is the radius of the pre-drilled hole, in mm; h is the depth of the pre-drilled hole, equal to the thickness of the substrate, in mm.

Figure S3. Diagram of bonding strength test.