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Bending strength of damaged timber beam repaired by adhesive-vacuumed method

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Abstract

Six scaled-specimens of glued-acacia beam were tested in bending and effectiveness of non-metal repair of damaged beam by epoxy adhesive-vacuumed method was investigated. Two failure modes of glued-acacia beams by bending test were crack in bottom center and split from edge. Different covering method was used for them. MOE of type A showed fairly good recovery after repair. However in comparisons both specimens between bending strength before and after repair remarkable degradation. The epoxy adhesive-vacuumed method in full cover condition was thought to be appropriate and bending strength has possibility to increase more. The reason is adhesive is difficult to permeate the crack inside of the beam, they can permeate mostly from the surface.

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Keywords: Bending strength ; non-metal timber repair ; vacuumed method

1. Introduction

Many traditional Javanese wooden houses have been destroyed by major recent earthquake and several of them tend to be dismantled due to a high cost of reconstruction and a lack of repair technique even though many of members were still free from sever damages except the joint [1]. In order to preserve this disappearing building as valuable and tangible culture, an evaluation and improvement of timber structures has been studied. Especially in this report, an appropriate repair method for damaged traditional joints without metal equipment was investigated.

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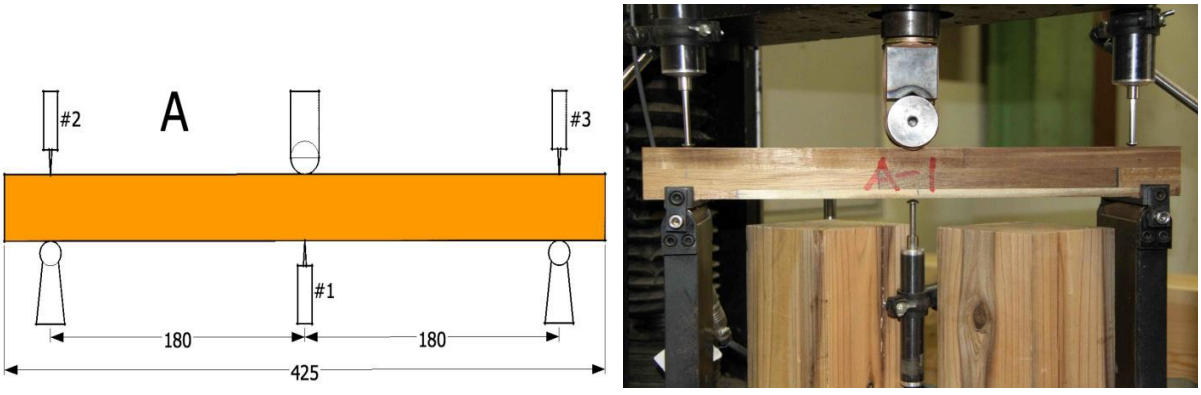
Valuable Javanese wooden buildings 'Joglo' have been destroyed due to major recent earthquake. A lot of them tend to be dismantled due to a high cost of reconstruction [2] and a lack of repair technique [3] even though many of members were still free from severe damages except the joint [1; 4], as seen in Fig. 5.1. In order to preserve this disappearing Joglo as valuable and tangible culture, an evaluation and improvement of structural performance is indispensable. Mortise and tenon joints of the core structure of Joglo building are the primary elements providing rotation resistance against lateral forces [5]. Besides the joint has the large deforming capacity through embedment performance of column toward the beam. Figure 5.2a and 5.2b show four columns at core structure and Joglo building that are severely inclined but still standing and securing human life during earthquake [4]. Hence, the role of joints is very important.

An experimental study is presented concerning the bending strength of scaled specimens of glued-Acacia wood beams. They were bent until failure under three-points bending in the first step, then repaired with an epoxy adhesive-vacuumed method [6][7]. In this study, comparison of bending strength between before and after repair was carried out and the effectiveness of the method was evaluated.

2. Materials and Method

In this study, a total of 6 specimens of beams made of glued-Acacia wood (40x40x425 mm) were tested in 3 point bending. Glued-Acacia wood is composed of several layers of dimensioned timber glued together by compressing several small pieces of wood. Finger joint was arranged 3 units in average to unity each member horizontally.

Figure 1 show set-up of bending test. Instron 100 kN were used to apply the static load at the center of the 2 supports (span= 360 mm) with speed of 0.5mm/min. The specimens were set so that the glue line of each lamina were arranged horizontally. The load was applied until failure and the load return to zero. Then specimens were repaired by epoxy resin. Figure 2 show repair preparation of damaged beams by epoxy adhesive-vacuumed method. Specimen A was split from the edge and it's full covered by fiber and plastic sheet. Specimen B was crack at the bottom center and it's spot covered by fiber and plastic sheet. A plastic bottle as glue container put on the top center of damaged area. After the bottles filled by epoxy resin (commonly used for concrete repair, E206W), the bottles were vacuumed for 1 hour so that the resin permeates along the bending cracks due to the air pressure. The adhesive-vacuumed method was adopted cause of material availability and machinery, and metal free ideology of traditional community. After curing for 3 days, the repaired specimens were tested again in 3P bending. The same loading methods were used before and after repair. After all loading program was over, all of specimens were cut to confirm the epoxy adhesive was able to fill surely by vacuum method. After test, part of all specimens was oven dried on temperature of 105oC to obtain moisture content of specimens.



(a) (b)

Fig. 1. Bending test set-up (a), real test specimen (b)