UNIVERSITI TEKNOLOGI MARA

THE EFFECT OF FINGER JOINT PROFILE AND ORIENTATION ON THE STRENGTH PROPERTIES OF TIMBER BEAM FOR SELECTED MALAYSIAN TIMBER SPECIES

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Civil Engineering

July 2016

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

The jointing together of timber member plays a very important role in the construction of timber structure because all timber structures are made of elements that must be connected together for the transfer of loads between them. Of the failures observed in timber structures, most are attributed to improper connections design, construction (fabrication) detail, or serviceability. Timber connection can be divided into two categories which are mechanical joints and end joints. For end joints, three possible end-joints might be considered in timber connection; butt joints, scarf joints and finger-joints. Finger-joints offer the best way of joining wood, since they provide high strength, not wasteful of wood and can be manufactured at high production rates. Finger joints are type of structural end joint used in glue laminated timber (Glulam) to form long, continuous lamination out of individual pieces of timber. Finger-joint strength evaluations have been well documented on temperate species. Extensive studies have also been conducted on methods used to finger joint and the effect of finger joint profile to the strength of timber. However, little information is available on finger jointing of Malaysian tropical hardwoods especially finger profile geometry and orientation for optimum strength. This thesis reports on the research work carried out in determining the effect of finger-joint length (15 mm and 25 mm), orientations (horizontal and vertical) and species of Malaysian timbers (Kapur, Merpauh, Resak, Bintangor, White Meranti, Sesenduk and Kelampayan) on the strength properties of finger jointing as connections in timber beams. The bondability of adhesive to timber, thick adherend shear test and contact angle were conducted. Non-destructive test (NDT) was also performed. The results showed that there is no significant difference in the joint strength of the beams for all species in terms of finger lengths and orientations. The failure modes of the failed bending specimens were observed and it was found that timbers in lower strength groups (SG 6 and SG7), failed mostly in timbers. However for higher strength groups' timber (SG 4 and SG5) the failures were mostly in adhesive failure. These results correlate well with the thick adherend shear test and contact angle tests. The NDT tests were conducted to see if this method can be used to predict the MOE of finger jointed beam. The test results for NDT tests showed that is no correlation in the dynamic MOE and static bending MOE.

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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

Timber, as one of the best construction materials of the world, presents nearly unlimited applications. It has an attractive appearance and a long lifespan, it handles with easy and its strength/weight ratio is high. No other construction material is as much ecological as timber. Recently in Malaysia, the application of timber structures in construction is still at minimum level. Generally, the use of timber mainly focuses on simple structures or structures that can take small loads such as roof rafters, short span roof trusses, beams and columns for houses which are not more than two storeys. This is because some engineers did not confidence to use timber to sustain high loads such as bridges or long span structures. In addition to that, recently as a result of a number of failures the popularity of timber is declining (Jumaat *et al.,* 2005). The reasons given for the decline are a strong indication that most people do not have accurate knowledge about the physical and mechanical properties as well as the performance of timber (Baiden *et al.*, 2005). Also, Malaysian Building By laws 1984 specified that timber should be avoided in high-risk constructions and could only be used in temporary structures (Kong-Ong., 1987). However, many failures in timber building in the past have shown us the safe method of construction, connection details and design limitations.

Timber has more advantages compare to steel and concrete as it has higher strength to weight ratio. It also easily to work with as it can be easily fabricate and construct using simple machinery and inexpensive jigs which requires less labour construct and time because of the quick erection process. Mechanical properties of the air cells trapped within its cellular structure of timber manage it for the best insulator of all the structural building materials. Concrete is about ten times more thermally conductive than wood, while steel is about 350 times more thermally conductive. Benefits from timber also from its natural growth characteristics such as grain patterns, colours and its