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Effect of span-to-depth ratio on flexural properties of wood filled steel tubes

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Abstract

This paper presents the results of experimental investigation to study the effect of span-to-depth ratio on flexural properties of teak wood filled steel tubes. The effect of span-to- depth ratio on teak wood and steel tube has also been carried out. It is observed that smaller span to depth ratio gives lower values of Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) because of shearing effect. In case of higher spans the beam is subjected to pure bending and hence flexural properties are higher in all three cases of the beams. The span to depth ratios used in this paper also prove that they are inline with recommendations of ASTM procedures for determining the flexural properties of wood and wood based composites. The studies carried out prove that recommendations of the standards for wood and wood composites can very well be extended to wood filled steel tubes.

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Keywords:Span to depth ratio; Flexural propertie; Modulus of Elasticity; Modulus of Rupture,Wood filled tubes.

1. Introduction

Composite materials play important role in reducing weight of structure; various possibilities of composites can be obtained by varying the size of the two or more materials that forms the composite.Strength properties usually reported include modulus of elasticity, modulus of rupture, compression strength, tensile strength; shear strength, fastener holding capacity, and hardness.There are two major reasons of current interest in composite materials. Thefirst one is to satisfy the need for materials that will outperform the traditional monolith materials and composite

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offers engineers the opportunity to design totally new materials with precise combination of properties needed for specific tasks.

Nomenclature

A	cross sectional area of specimen
B	breadth of specimen
E	edgewise (in WFT360E-10)
F	flat wise (in WFT360F-1)
H	depth of specimen
I	moment of inertia of specimen
L	length of specimen
Ls,	Span
Ls/H	span-to-depth ratio
M	bending moment
m	mass of specimen
MoE	modulus of elasticity
MoR	modulus of rupture
Pmax,	maximum load
Ppl	load at proportionality limit
ST	steel tube
TW	teak wood
V	volume of specimen
WFT	wood filled tube
Δmax	deflection at maximum load
Δpl	deflection at proportionality
ρ	density of specimen

Borri et al. (2011)presents an experimental study on the strengthening of wood beams under loads through the use of very high strength steel cords. An experimental program based on four-point bending test configuration is proposed to characterize the stiffness, ductility and strength response of wood beams strengthened with steel chord. Mechanical tests on the strengthened wood showed that external bonding of steel fibers produce high increases in flexural stiffness and capacity. Adherence between the wood and reinforcement was effective up to the fracture in the wood beams. Wu et al. (2011) presented investigation study on the size effect and the flexural behaviour of full size reinforced concrete beams with lightweight aggregate and normal aggregate. A total of 6 flexure beams with various reinforcement ratios and 6 size effect beams with various dimensions were fabricated and tested. The designated compressive strength of concrete is 34 MPa. Test results indicate that the reinforced lightweight aggregate concrete (LWAC)beams have similar load capacities and failure mode as that of Normal Weight Concrete(NWC).

Ghao and Liu (2004) present a study of flexural behaviour of high strength rectangular concrete filled steel hollow section. The specimens tested to failure under pure bending. Three different sizes of steel hollow sections were filled with high strength concrete. A good ductility performance of the specimens was observed in all specimens. Local buckling was specifically noted on the compression face of the specimens. The study concludes that more studies are needed to understand the behaviour of rectangular CFSHS with high strength materials.

Danawade et al. (2012) studied the effect of tolerance on the flexural properties of wood-steel composites with span-to-depth ratio of 14 and concluded that there is no effect tolerance on the flexural properties. Danawade et al. (2013) investigated the flexural properties teak wood, hollow sectioned steel tubes and teak wood filled steel tubes using span-to-depth ration of 7.86 which is lower than that the recommended in above standards. As the shear effect is greater in beams with low span-depth ratio and materials with low shear modulus it is necessary to consider higher span-to-depth ratio to eliminate the effect of shear.