CHARACTERIZATION OF FATIGUE PROPERTIES OF BONDED-IN PULTRUDED ROD TIMBER CONNECTION

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BY :

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Contents

2. Letter of Offer (Research Grant)

UNIVERSITI TEKNOLOGI MARA

PEMENANG Anugerah Kualiti Perdana Menteri 2008

Surat Kami : 600-RMI/ST/DANA 5/3/Dst (190 /2011)
Tarikh : 27 Mei 2011

Profesor Madya Dr Zakiah Ahmad
Fakulti Kejuruteraan Awam
Universiti Teknologi MARA
40450 Shah Alam

Y. Brs. Profesor/Tuan/Puan

KELULUSAN PERMOHONAN DANA KECEMERLANGAN 05/2011

Tajuk Projek	:	Characterization Of Fatigue Properties Of Bounded-In Pultruded Rod Timber Connection
Kod Projek	:	600-RMI/ST/DANA 5/3/Dst (190 /2011)
Kategori Projek	:	Kategori G (2011)
Tempoh	:	01 Jun 2011 – 31 Mei 2013 (24 bulan)
Jumlah Peruntukan	:	RM 9,000.00
Ketua Projek	:	Profesor Madya Dr Zakiah Ahmad

Dengan hormatnya perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan pihak Universiti telah meluluskan cadangan penyelidikan Y. Brs Profesor/tuan/puan untuk membiayai projek penyelidikan di bawah Dana Kecemerlangan UiTM.

3. Bagi pihak Universiti kami mengucapkan tahniah kepada Y. Brs. Profesor/tuan/puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

4. Peruntukan kewangan akan disalurkan melalui tiga (3) peringkat berdasarkan kepada laporan kemajuan serta kewangan yang mencapai perbelanjaan lebih kurang 50% dari peruntukan yang diterima

Peringkat Pertama	20%
Peringkat Kedua	40%
Peringkat Ketiga	40%

5. Untuk tujuan mengemaskini, pihak Y. Brs. Profesor/tuan/puan adalah diminta untuk melengkapkan semula kertas cadangan penyelidikan sekiranya perlu, mengisi borang setuju terima projek penyelidikan dan menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

MUSTAFAR KAMAL HAMZAH
Ketua Penyelidikan (Sains dan Teknologi)

5. Report

5.1 Proposed Executive Summary

(Original proposal – 300 words) – 1 page only

Connectors, such as bars (which include bolts, rods and dowels) and plates, are bonded into timber with high strength adhesives to produce concealed timber connections or composite structures. To optimise the mechanical performance of adhesively bonded timber composites, failure should preferentially initiate in either the timber or in the reinforcement. A good adhesive bond does not initiate through de-bonding between the composite elements.

Bonding of steel rods to wooden members has been investigated by relatively large number of researchers. This jointing system resulted in enhanced performance over a bolted connection with the same diameter. Bonding of steel rods into timber members has been extensively investigated by Broughton and Hutchinson [2001] who indicated that efficient, high strength joints can be made with epoxy adhesives due to their capability to produce thicker gluelines. A good bond between wood and steel must be at least the same strength as the wood and in outdoor applications it should be durable enough to withstand repetitive wetting and drying cycles as well as large temperature changes.

Joint using steel pultruded rod has been established. Since the use of steel as fastener has introduced problems in the timber joint, there is a need to look at alternative materials. This study is exploring the potential of glass fiber reinforced plastić(GFRP) rod in the bonded-in timber connection.

Most of the studies bonded-in connections have concentrated on static mechanical properties rather than fatigue. For these materials to be effectively used in engineering applications, their behaviour in fatigue is of considerable interest. This study therefore aims to characterize the fatigue life of bonded-in timber connection and to observe damage development under cyclic loading. Lifetime analysis will be performed using S-N data to produce constant life lines.

This fundamental study is unique and will offer new information about pultruded rods to adhesive to timber interactions under static and cyclic load. A thorough evaluation in fatigue will allow the use of bonded-in connection in bridges and buildings where dynamic loads are experienced.

5.2 Enhanced Executive Summary

(Abstract of the research) – 1 page only

Joint using steel pultruded rod has been established. Since the use of steel as fastener has introduced problems in the timber joint, there is a need to look at alternative materials. This study is exploring the potential of glass fiber reinforced plastic(GFRP) rod in the bonded-in timber connection.

Most of the studies bonded-in connections have concentrated on static mechanical properties rather than fatigue. For these materials to be effectively used in engineering applications, their behaviour in fatigue is of considerable interest. This study therefore aims to characterize the fatigue life of bonded-in timber connection using GFRP and to observe damage development under cyclic loading. The strength proeprties were investigated under static and tension-tension (R=+0.1) fatigue loading. The bondability of the connection system were also measured under block-shear and pull-out test. Lifetime analysis was performed using S-N data to produce constant life lines.The timber species used were from different strength groupings (SG) namely, Kempas (SG2), Keranji (SG3) and Kedondong (SG5).

The results demonstrated that the fatigue life increased as the peak dynamic load is reduced. The parameters Better static strength was measured for Keranji compared to Kempas and Kedondong. However Kedondong able to sustain longer cyclic loading.

5.3 Introduction

Timber is one of the oldest construction materials used by mankind, due to it being a readily available natural resource. Timber has many advantages over other commonly used building material (such as steel and concrete) including its availability, workability, strength to weight ratio, renewable resources and very importantly its low impact on the environment.

By adopting the timber as the construction material or structural members, timber needed to be connected or to become longer or jointed to other members. Due to structural application, timber must go through proper jointing or connecting process. Not like as the steel or concrete structure, it can be welded or re-fabricate to connect each members. The traditional timber connection systems based on fasteners such as nails, bolts, screws and dowels, may not be preferred choice of systems for heavy timber structures because of some disadvantages associated, e.g. long manufacturing times, high labour cost, heavy joints and corrosion problems (Mehrab and Martin, 2003). New types of timber connections such as glued-in bolts or rod and bonded-in connection have been introduced to remove some disadvantages of traditional joints. This study focused only on bonded-in timber connection system into the selected timber species.

Bridges are one of the example of fatigue loaded structures. In timber bridges the attention does not concentrate on the average cross section but on the details. The detailing, i.e. the connections, notches and other disturbances of the cross sections, all unite in a common tendency to introduce stress singularities often with stresses utilizing the weak and brittle shear and tension perpendicular to grain strengths. The timber connected members not only sustain the direct load (deflection)