

UNIVERSITI TEKNOLOGI MARA

**FRACTURE MECHANICS ANALYSIS OF
PRESTRESSED CONCRETE RAILWAY
SLEEPERS CONTAINING FIBRES**

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Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy

Faculty of Civil Engineering

November 2010

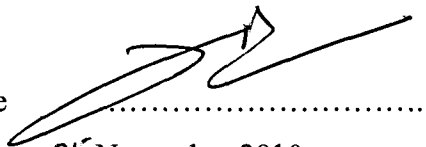
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ABSTRACT

The Malaysian rail industry has developed tremendously over the last decade in order to play a major role in providing better alternative for road users. Taking a cue to future developments, sleeper demand will also increase. However, these prestressed concrete sleepers are mostly prestressed concrete types designed with less emphasis on dynamic irregularities of the train or the rails that generate fatigue loads. Cracks could develop during a train passage which can be a threat to the overall stiffness properties as they can propagate further under repeated loads. By utilising fibres, namely polypropylene as crack arresters, the behaviour of the sleeper would definitely change. Thus the research work presented in this thesis is focused on the performance of fibred prestressed concrete sleeper (HSFRC) under static and fatigue loads. Preliminary material study was carried out to select a new mix design of high strength concrete containing fibres. A major part of the laboratory investigation covered on the preparation of the sleeper itself and compliance to design requirements. There were no formations of cracks or crack propagations in the sleepers under constant and variable amplitude loads, testifying that fibres were effective in crack resistance. The proposed fibred-sleeper was capable to resist 97% of the yield strength after the occurrence of first crack and has a maximum strength capacity of 36% higher than the non-fibred sleeper (HSC). The residual strengths at post-fatigue remained almost similar for both types of sleepers depending on the cyclic stress ratios, but failures of the non-fibred sleepers were severe. Analysis sought by Linear Elastic Fracture Mechanics (LEFM) was extended using static test results and found that equivalent fatigue characteristics and life of sleepers had all been improved significantly. These include fracture toughness properties, stress intensities and crack growth rate. The fibres were effective to control cracks and its life is predicted at 86% more than the non-fibred sleepers.

ACKNOWLEDGEMENTS

Firstly, I am most thankful to **ALLAH**, The Most Gracious (Ar-Rahman) and The All Knowing (Al-'Aleem) for giving me the opportunity to seek knowledge in the true sense. I would like to record my gratitude to the *Universiti Teknologi Mara*, Malaysia for the scholarship that enabled me to pursue the research work; to the Bureau of Research and Consultancy (now known as Research Management Institute) for funding the research grant; and to the Faculty of Civil Engineering for the laboratory facilities provided.

I would like to acknowledge my deepest appreciation and recognize all the contributions of Professor Dr. Hajjah Khafilah Din as my supervisor. Although she went for early retirement, she had continually given her encouragement, criticisms and moral support that I need during the course of the work. A thank you is also due to Professor Dr. Wan Mahmood Wan Abd Majid for his kind assistance.

Writing of the draft was frequently postponed due to health condition that resulted with both minor and major operations. Thus, this thesis would not be completed without the continuous and sincere moral support and understanding from my husband, Haji Azhari Ahmad, my children, Afzal, Azfar and Aqilah; family members and friends. I would also like to record my appreciation to the laboratory staff, especially to Haji Mat Som Marwi, Ahamad Razman Arshad and Zu Iskandar for their kind assistance; to Mr. Vasanthan for sharing his knowledge on the tensioning works. Only **ALLAH** rewards them.

Finally this work is also dedicated to the memory of my parents, Haji Abu Bakar Mohamed and Hajjah Maimunah Othman for all their love; Haji Hashim @ Mohd Said Abdullah and Haji Abdul Rahim Othman, whom had given me lots of moral guidance and inspiration and all whom had passed away while I was doing the research. May all be rewarded with Jannah.

Afidah binti Abu Bakar,
Shah Alam.

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