INDIRECT TENSION TEST OF HOT MIX ASPHALT AS RELATED TO TEMPERATURE CHANGES AND BINDER TYPES

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"Special dedication to my beloved parents Abu Bakar Bin Mahmud (rest in peace) and Sepiah binti Ali,

My brothers, Ahmad Fahmi, Ahmad Supian and Shamsul,

My sisters, Norhaslina, Noor Arifa and Raja Nor Qeeblat,

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ABSTRACT

Hot Mix Asphalt (HMA) can deteriorate and crack due to the repeated loading from traffic and change in temperature. This study is to evaluate the effects of temperature and binder types to the strength of asphalt layer. Four types of hot mix asphalt were considered in this study which were AC 10, AC 14, PMA 10 and PMA 14 and have been evaluated in the laboratory. For each type, the strength of the mixes have been compared related to different temperatures which are 25ºC and 40ºC using the Indirect Tension Test machine for resilient modulus according to ASTM D 4123 and the effect of binder types was also observed between bitumen type pen 80/100 and performance grade (PG) 76. Optimum bitumen content from Marshall Test results show that for AC10, AC14, PMA10 and PMA14 are 6.3%, 5.2%, 7.2% and 6.0% respectively. From the Indirect Tensile Modulus Test results it clearly shows that the values of resilient modulus decrease when the temperature is increase. AC10 and AC14 with bitumen 80/100 had higher resilient modulus at 25ºC compared to PMA10 and PMA14. However, at 40ºC the PMA10 and PMA14 shows vise versa. Bitumen pen 80/100 is suitable for low temperature condition because it has high resilient modulus value compared to PG76 but for high temperature, it is otherwise. From this study, PMA14 is found to be the best mix having the highest resilient modulus of all at 40ºC temperature, thus it is suggested that for Malaysia climate condition where the highest surface temperature is between 40ºC to 50ºC, PMA14 design is more suitable and will increase the pavement strength and lengthen the service time.

ABSTRAK

Sebahagian daripada punca kerosakan dan keretakan pada asphalt campuran panas (HMA) adalah disebabkan oleh beban trafik yang berulang dan juga perubahan suhu. Kajian ini adalah untuk mentaksirkan kesan yang disebabkan oleh suhu dan juga jenis pengikat kepada kekuatan lapisan asphalt. Empat jenis campuran digunakan di dalam kajian ini iaitu konkrit berasphalt dengan saiz nominal 10 dan 14 (AC10), (AC14), dan juga polimer asphalt diubahsuai dengan saiz nominal yang sama (PMA10) dan (PMA 14) dan kajian ini telah dilakukan didalam makmal. Kekuatan bagi setiap jenis campuran telah dibuat perbandingan berdasarkan dua jenis suhu iaitu 25ºC dan 40ºC menggunakan mesin Indirect Tension Test berdasarkan ASTM D4123. Kesan disebabkan pengunaan jenis pengikat yang berlainan juga diperhatikan antara pengikat jenis pen 80/100 dan juga jenis performance grade (PG)76. Daripada keputusan ujian Marshall, nilai kandungan bitumen optimum bagi campuran AC10, AC14, PMA10 and PMA14 adalah 6.3%, 5.2%, 7.2% dan 6.0%. keputusan ujian daripada Indirect Tension Test jelas menunjukkan bahawa nilai resilient modulus akan berkurang apabila suhu meningkat. Campuran AC10 dan AC14 dengan mengunakan pengikat pen 80/100 menunjukkan nilai resilient modulus yang tinggi pada suhu 25ºC berbanding dengan campuran PMA10 dan PMA14. Walaubagaimanapun, apabila suhu mencecah 40 ºC keputusan ujian menunjukkan sebaliknya. Bitumen pen 80/100 juga didapati lebih sesuai untuk suhu yang rendah berbanding bitumen PG76 yang mempunyai nilai resilient modulus yang lebih tinggi apabila suhu mencecah 40 ºC. Hasil kajian secara keseluruhannya menunjukkan bahawa jenis campuran PMA14 adalah jenis yang paling sesuai digunakan di Malaysia.